ENGINEERING NEWS

The new pipe line from the Lima, O., oil field to Chicago, which was begun about three months ago, is rapidly nearing completion. As stated in our issue of April 13, the line is 210 miles long and will cost about $7,000 per mile. The work was divided into four sections, and a total force of 600 men has been employed. The method of conducting the work was as follows: The force of men on each section was divided into seven gangs: first, the pipe distributors, who laid the pipe along the railroad track; second, the placers, who laid the pipe end to end in a continuous line; third, the general levelers, who attended to the grading; fourth, the pipe joiners, using steam machinery to screw the lengths of pipe together; fifth, the ditchers, excavating a trench from 4½ to 20 ft. in depth, according to the nature of the ground; sixth, the pipe sinkers; and seventh and last, the back fillers.

In crossing streams a sufficient amount of pipe was screwed together to reach from bank to bank. It was then pulled across. An anchor weighing 700 lbs. was then attached to each joint, and the whole was dropped into the river. The anchors are expected to hold the pipe in place on the river bed.

The Lima pumps were recently started with water and the line between Lima and Laketon tested. No leaks were detected.

MR. JESSE H. LIPPINCOTT, of Pittsburg, is said to have bought all the rights and patents of the Edison Phonograph Company in the United States and Canada, including all Mr. EDISON'S patents relating to the phonograph, and all the improvements he may make on it in the next fifteen years. The price agreed upon is supposed to be about $1,000,000. Mr. LIPPINCOTT has also secured a license for fifteen years for the manufacture in the United States of the graphophone, the recent invention of Messrs. TAINTOR and BELL.

ACCORDING to a late interview with Dr. ADAM CARDENAS, now in New York, the recently appointed Nicaraguan Minister to Great Britain and one of the most prominent men in his State, the old American, Atlantic & Pacific Ship Canal Co., of which we now and then hear, has no legal or moral foundation for its claims to recognition in Nicaragua. The original enterprise was a Nicaraguan incorporation of 1850, and by virtue of the law of that land had ceased to exist many years ago. If in no other way, the time limit in the concession itself had long since terminated the rights of the grantees; and Dr. CARDENAS said that the claims put forward by a person calling himself "President of the American, Atlantic & Pacific Ship Canal Co." were therefore preposterous and without foundation or merit. Dr. CARDENAS was at one time Minister to the United States, and the President of Nicaragua from 1882 to 1886, and is therefore familiar from intimate experience with all questions connected with a canal across that State. He said his Government recognized no concession except that granted to the Nicaragua Canal Association, in 1887. He also remarked in connection with the latter enterprise, that the boundary dispute with Costa Rica was at an end; and it is now the common interest of the two countries, to foster and promote a work so important to their internal improvement.

THE statement that the New York Central company has secured a controlling interest in the Poughkeepsie bridge, which was noted last week, has been affirmed and denied, while no official information is forthcoming. So many schemes and deals have been promulgated in connection with this enterprise that the true inwardness of the whole is rather difficult to make out. A year or more ago it was generally understood that a syndicate, headed by W. W. GIBBS, of Philadelphia, had secured control of the bridge as well as of the old partially built Pennsylvania, Slatington & New England railroad, and were to complete the line for a through route from Pennsylvania coal fields to New England markets. It was also thought that the Pennsylvania and the Erie systems would be extended east to a connection with the bridge. For an eastern outlet the syndicate purchased the Hartford & Connecticut Western road, after an unsuccessful effort to obtain control of the New York & Massachussetts, which is the direct outlet from Poughkeepsie eastward and is much preferable to the crooked and roundabout Hartford & Connecticut Western. Several suits have been brought, indeed, to harass the New York & Massachusetts and browbeat its owners into a coalition with the bridge syndicate, all of which, however, have thus far come to naught. It has been rumored, too, that the strange delay in building connections to the bridge was due to a coalition among the railways interested, who proposed to inaugurate a sort of boycott of the bridge for a while, until the fixed charges of the company forced it into bankruptcy, when the railways themselves would secure control of it very cheaply. In support of the statement that the New York Central has secured the controlling interest in the structure it is plausibly alleged that its purpose in the purchase is a defensive one. Having control of the principal traffic between the West and New England, it does not wish to see several rivals running over a short line by way of Poughkeepsie, and as the bridge makes a handy cross-over between the West Shore and Hudson River roads and promises to be a profitable investment as a western outlet for the New York & New England, which stock the Vanderbilts have been quietly gathering in for some time, it will doubtless be a very valuable bridge for the Central to own.

THE will of the late HIRAM SIBLEY bequeaths $30,000 to Cornell University to endow a Professorship of Mechanic Arts.

As elsewhere intimated, the steamer *Colorado* from Colon brought the following members of the Nicaraguan Survey to New York this week:—Sub-Chief Engineer R. E. PEARY; W. J. MAXWELL, U. S. N.; F. C. DAVIS, Chief of Party on Eastern Division; 1st Assistant Engineer P. H. BEIRER, and rodman DIEBITSCH and Secretary C. E. KERN. Some of these gentlemen have already called at our office, and their bronzed and generally robust appearance speaks volumes for the climate and conditions of life in Nicaragua. Not a single member of the party has been seriously ill or suffered any material injury as a result of six months field work. Mr. PEARY brings with him the notes, profiles and maps of the work done, and abundant data for developing the general plan and detail work, and making careful estimates of cost. In general terms it may be said that the new location reduces the length of canal in excavation. and increases the length of free navigation over the route of 1885. The survey has been made in great detail with all difficult parts cross-sectioned at 100 ft. intervals; the topography is very ample, and all important detail work has been plotted on a scale of 400 ft. to the inch with 10 ft. contours. Borings have been made at every lock, dam or embankment to be constructed.

THE latest reports from the Nicaraguan Survey in the field are dated from Rivas, July 7. From these we learn that Mr. LEBARON, who is in charge of the force remaining in Nicaragua, will survey the San Carlos river and complete the details of the San Francisco valley survey. He will also run a trial line from the valley of the Limpio to the "divide," where it is expected that a shorter cut through will be found than the one surveyed on the Saltos route. In the Western Divisions, Mr. PEREZ has completed a new location of a portion of the route, with the satisfactory result of extending the free navigation through the basin of the Tola 0.45 miles; thus saving 5.28 miles in canal excavation instead of 4.83 miles as previously reported. The amended figures for the canal in excavation are now:

Ochoa to Greytown	17.17 miles.
Western Division	11.72 "
Total canal in excavation	28.89 "

The estimated cost, based on the same prices, will be much below the figures of the 1885 survey. Mr. MENOCAL will soon return to the United States and give his personal attention to the office work of fixing upon the general plan of building the canal, the position of the locks, their design and dimensions, and the many details which do not form a part of the survey proper. Full data is now in hand to determine all questions involved.

THE Westinghouse Electric Company, of Pittsburgh, has acquired the patents and inventions of NIKOLA TESLA, who is said to have successfully solved the problem of a motor to be run by an alternating current. If these reports can be relied upon, the new device accomplishes in a commercially successful manner what had been pronounced absolutely impossible by some electricians and eagerly striven for by others, and will certainly be a great advance in electrical science. The Westinghouse Company, which uses the alternating current for lighting, will now be able to supply a current for running motors with the same plant used for lighting, which has heretofore been idle during the day. Careful practical tests are said to have given very favorable results, and motors of all sizes from the smallest fan motor up to about 40 horse power are now being constructed. The new motor is said to be extremely simple both in construction and operation. There are no brushes or commutators and the device permits a variation in the speed of the armature, or its almost immediate reversal. The only winding required by the armature is a single layer of small wire, with the ends joined together, but having no connection with the external circuit, the secondary current which does the work being induced in the armature.

ANOTHER international South American railway scheme is said to be afloat, contemplating a connection of existing roads by new track, to the extent of 2,000 miles, from Buenos Ayres, through Paraguay, Bolivia, Peru and Ecuador to Bogota, and thence to the coast either at Carthagena or Panama. As the twenty or more existing Argentine railways have been built at an average cost of $40,000 per mile, the promoters claim that the line could be finished for $80,000,000. While this estimate is doubtless much too low, when the flat and broad Argentine plains are compared with the very difficult mountainous work that must lay in the path outlined, the country to be traversed is so rich in auriferous wealth and in agricultural possibilities, that the end would doubtless justify the necessary means. The world would be the gainer by such a road; but whether South America is ready to build it or able to protect the interests of others who might put money in it, is another question.

THE Commissioner of Patents has prepared and issued a revision of the rules of practice in the Patent Office. The changes have been made with a view of preventing unnecessary delay in the issuance of patents. Hitherto, under the law and the rules of the office, an applicant might, after establishing his right to a patent, place his invention on the market as "Patent applied for", and by manipulation postpone the actual issuance of the patent nearly 4 years, thus extending its term and prolonging his monopoly to nearly 21 years, instead of 17 years, as contemplated by law. The Commissioner's revision will prevent, so far as he is able this evasion of the spirit of the law.

ACCORDING to the report of the late Col. W. MCFARLAND, the last year's dredging operations at Gedney's Channel in New York Harbor has produced a navigable channel throughout not less than 500 ft. wide and 26 ft. least depth on the bar, and 25.4 on the shoal west of Flynn's Knoll in the lower bay. This permits steamers to go to sea at high water loaded 2 ft. deeper than formerly. No shoaling has occurred during boisterous weather in the new channel and the channel has deepened slightly from natural causes. The report says that $500,000 should be appropriated next year for removing debris at Flood Rock and obstructions at Hell Gate.

THE controversy over the partition of the expense attendant upon the removal of the grade crossings on the New York, New Haven & Hartford Railroad in Connecticut has been brought to notice again by a decision of Judge TORRANCE of the Superior Court that the entire expense must be borne by the railroad company. The case will be carried to higher courts, however.

THE Spanish government guarantees 8 per cent. on $4,964,000 for the building of 120 miles of railway in the far-off Philippine Islands.

The Practice of Exact Railway Location with Taper Curves.

BY FRANK OLMSTED, LOCATING ENGINEER.

Concluded from page 44.

PROBLEM No. 2.

The "L" line is given from station 820 to 841+14.2 with the included angles. At station "L" 820+80 the "E" line intersects, bearing 8°32' right. From the paper location trial line it is found that a curve ought to pass through "L" 823+50:25 ft. left of "L', 827, cross at "L" 830 bearing right,and again at "L"

Location With Taper Curves. Problem 2.

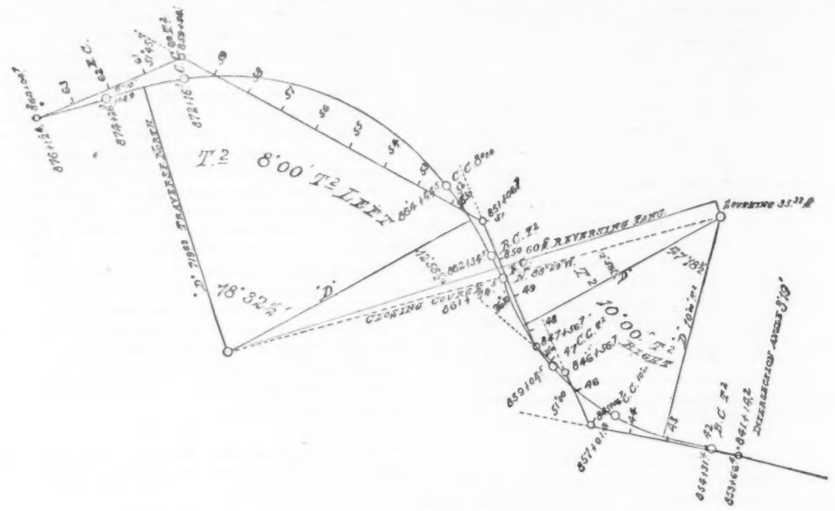
833 bearing left, and that the resultant tangent from the curve should pass 24 ft. left of "L" 837 and intersect at "L" 8.41+14.2—a 3° curve Taper 1 compounded with a 7°curve Taper 2 are found to nearly comply with these conditions. To find the proper alignment notes:

We make the B. C. of the 3°00' T 54 ft. back from intersection, which was "E" 833+60.4,giving us "E" 833+06.4 B. C. This is scaled from the map, but is final. Starting a traverse at the center end of "D" 3°00' T', calling its course North; thence 90° 00' left 21 ft. to intersection with "L"; thence, turning 171° 28' right onto"L",and following it to"L" 837; thence 90° 00' left 24 ft. and thence to "L" 841×14.2; the course and distance of which is found by reducing the triangle whose base is the distance from "L" 837 to "L" 841+14.2 and whose height is 24 ft. The full traverse is as follows.

Angle	Bearing	Dist'ce	N	S	E	W
	North	1910.57				
90°00'L	West	21.00	1910.57	.....	.....	21.00
171°28'R	N81°28' E	147.50	21.89	.....	145.86	
25°00 R	S 73°32' E	953.00	.....	270.14	913.91	
44°58' R	S 28°34' E	519.50	.....	456.26	248.41	
90°00 L	N61°26' E	24.00	11.48	.....	21.08	
93°19' R	S 25°15 E	414.9	result'nt tangent	375.26	176.98	
			1943.94	1101.66	1506.24	21.00
			1101.66		21	
			842.28 Northing		1485.24 Est'g	
			Closing course=S 60°26½' W			
			Distance, 1707.48			

This closing course is 4° 18½' from a right angle to the "resultant tangent". This triangle whose acute angle is 4° 18½' figured out, gives base of 1702.67 and upright of 128.28 the first being the distance from "resultant tangent" on a right angle to center of 3° 00' curve; the other, the distance beyond the intersection Q. R. From the diagram it is seen that "D" of the 7° 00' curve and this last line (distance 1702.67) are parallel. Taking the radius of 7° curve from that of 3° curve we have the distance 1091.27—Taking "D" of 7° curve from 1702.67 we have 881.85 for the base of a right angle triangle whose hypothenuse is 1091.27: and whose acute angle (to find) will be the curvature in the 7° curve; and whose upright (to find) will be the distance from "D" of 7° 00' curve on tangent to 128.28 ft. beyond intersection. Reduced, this gives 36° 05' for the curvature in the 7° curve, and taking "t" of 7° T2+128.28 from upright (642.65) gives 424.4 ft. beyond end of curve to intersection with "L" line.

From the traverse we find a nominal bearing of original tangent of West (east) and of the tangent sought of S 25° 15' E. This gives 60° 45' as the actual curvature to be developed by the two curves. We have seen 36°05' is the curvature of the 7° curve so 28°40' must be that of the 3° curve. This, then gives us the necessary data from which to write up the running notes. Like the preceding problem



Location With Taper Curves. Problem 3.

the taper curvature must be deducted from the total curvature in the curve and the taper distances taken from table.

TRANSIT NOTES.

"E" Location 88.

Intersecting angle 3°19' Left.

E. 853+66.9="L"841+14.2

849+42.5 E.C. 6°18'

847+62. 5C.C. T2 29°47

843+37.0 C.C. 7°00' 26°25'

833+60.4 C.C. 3°00 R. 2°15

E. 833+60.4 B. C. T'

PROBLEM No. 3.

Here we find from the paper location that to commence Taper 2 10°00' right at E. 854+31.4 with a

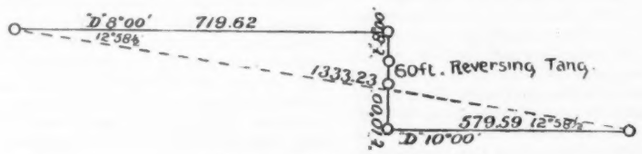


Diagram Showing Long Chord.

"resultant" reversing tangent of 60 ft., followed by a Taper 2 8°00' curve whose resultant tangent shall intersect the "L" 864+04.7 bearing 6° 10' to the right, is the best we can do with the ground. To find the proper alignment notes:

We drop "D" 8°00' T 2 on to the "resultant" tangent 290 ft. back from the intersection at "L" 864+04.7. This we judge to be nearly right from office location map. How near right will appear from the solution to follow.

Angle.	Bearing.	Dist.	N.	S.	E.	W.
90°00' *L*	North.	719.62	719.62	.....	.....	
73°50' *R*	West.	290.00	.....	.....	.....	290.00
	N83°50' E	410.00	44.04	.....	407.63	
51°45' *R*	S44°25' E	888.00	.....	634.27	621.48	
38°30' *R*	S 5°55' E	350.00	.....	348.13	36.08	
25°10' *L*	S32°05' E	100.00	.....	84.73	53.11	
21°00' *R*	S11°05' E	150.00	.....	147.20	28.84	
51°00' *L*	S62°05' E	392.50	.....	183.76	346.82	
176°41' *L*	N58°46' W	199.66	103.53	.....	.....	170.72
90°00' *R*	N31°14' E	579.59	495.58 "D" of 10°00' curve	.....	300.53	
			1362.77	1398.09	1794.49	460.72
				1362.77	460.72	
				35.32	1333.77	

Closing course = N 88°29' W. Distance = 1334.23 ft.

Starting a traverse at center end of this "D" of 8°00' curve, calling its course north, we turn 90°00' left 290 ft. to point of intersection—thence backward on "L" line to intersection at station 841+14 2, the intersection angle being 3°19', and the E station, 863+664; thence on "E" line to center of 10°00'. Traverse as follows:

This closing course is the distance from center of 8°00' left to center of the 10°00' right curve, if the assumption of the 290 ft. westing in the traverse shall prove correct. From the following figure we obtain the actual distance between the centers of curves.

From this we see our closing course of 1334.23 is one foot out of the way, and as the southing 35.32 is a settled quantity, the easting must be at fault. With a fixed southing of 35.32 and hypothenuse of 1333.23 we find base or easting of 1332.77. This shows the whole figure to be one foot too far west and the original "D" ought to have dropped from center 291 ft. back from intersection. The acute angle of 12°58½' in diagram is taken from the corrected closing course (in this case not changed). We see the curvature in the 8°00' T 2 to be 78°32½'. From the traverse we see nominal bearing of "D" 10° curve is N. 31° 14' E. The corrected closing course being N. 88° 29' W. gives curvature of 60°17'. This includes the 12°58½', which deducted gives actual curvature in the 10° T 2 of 47°18½'. We then have the data for the following running notes:

Intersection Angle 6° 10' Left.

E. 876+12.4="L" 864+04.7.

874+26.3 *E C.* 8°24

872+16.3 *C C T2.* 61° 44.5

864+44.5 *C C* 8°00' Left. 8°24

862+34.5 *B C T2.*

861+74.5 *E C.* 13°30'

859+04.5 *C C I 2.* 20° 18½'

857+01.4 *C C* 10°00' Right. 13°30'

854+31.4 *B C T2.*

E. 853+66.4=841+14.2 "L" Intersection angle 3° 19'.

From these detail notes on the practical working of calculated location in connection with taper curves it is believed the young engineer can derive some useful hints. Problems as varying as the districts over which a locator may work will arise, but there is always a similarly simple solution. Beginners should guard against requiring too much from the figure; that is, the previous determination of too many points from the drawing, and then attempting to force the curve to comply.

Tonnage of Cleveland, O., Street Traffic.

At the April meeting of the Civil Engineers' Club of Cleveland, O., Mr. D. TORREY read a paper on the above subject, which we abstract as follows:

Starting with the assumption that the estimated tonnage on the streets of that city was too high, and the pavement service correspondingly over-estimated, the author was lead to take an account of a full week's tonnage, Sunday included, and at a season of the year which was believed to give a fair record of the yearly average.

The blanks used, and the instructions given to the observers were slightly modified from those used by Capt. F. V. GREENE, late U. S. Eng'rs., in his street records noted in Transactions Am. Soc. C. E., Feb. 1886. Two men were employed who relieved each other for meals and rest. The hours of observation from 6 A. M. to 6 P. M., the streets being practically vacant before and after these hours.

TABLE NO. I.

TRAFFIC CENSUS RECORD OF STREETS IN CLEVELAND, O.

(Taken in March, 1888.)

Giving the total number of *Vehicles* and *Horses* passing the points of observation during 12 hours, (from 6 A. M. to 6 P. M.) for the whole number of days stated respectively, and the tonnage of the same.

CLASSIFICATION.	EUCLID AVENUE. (Seven Days.)			SUPERIOR STREET. (Seven Days.)			SUPERIOR ST. VIADUCT. (Two Days.)		
	Total Number.	Wt. Net Tons. Each.	Total.	Total Number.	Wt. Net Tons. Each.	Total.	Total Number.	Wt. Net Tons. Each.	Total.
Vehicles under 1 ton, Walking.	469	.....	.....	7,195	.....	.....	982		
Vehicles under 1 ton, Trotting.	9,765	.....	.....	22,357	.....	.....	3,598		
Vehicles under 1 ton, Speeding.	25	.....	.....	1	.....	.....	16		
Total	10,259	0.5	5,130	29,553	0.5	14,777	4,596	0.5	2,298
Vehicles 1 to 3 tons. Walking.	197	.....	.....	1,216	.....	.....	303		
Vehicles 1 to 3 tons. Trotting.	135	.....	.....	315	.....	.....	78		
Total.	332	2.0	664	1,531	2.	3,062	381	0.2	762
Vehicles over 3 tons. Walking.	3	.....	.....	33	.....	.....	15		
Vehicles over 3 tons. Trotting.	2	.....	.....	7	.....	.....	2		
Total	5	4.0	20	40	4.	160	17	4.	68
Total Number of Vehicles	10,596	.....	5,814	31,124	.....	17,999	4,994		3,128
No. of Horses. Walking.	997	.....	.....	11,654	.....	.....	1,802		
No. of Horses. Trotting.	12,276	.....	.....	26,994	.....	.....	4,402		
No. of Horses. Speeding.	25	.....	.....	1	.....	.....	21		
Total	13,298	0.5	6,649	38,649	0.5	19,325	6,225	0.5	3,112
Total Vehicle & Horse Tonnage	.....	.....	12,463	.....	.....	37,324	.....	.....	6,240

Records taken at No. 521 Euclid Avenue, No. 235 Superior Street, and at east end of viaduct.

TABLE NO. II.

DAILY AVERAGES OF TONNAGE ON CLEVELAND, O., STREETS.

(March, 1888.)

CLASSIFICATION.	EUCLID AVENUE, 42 ft. wide, no R. R. tracks.		SUPERIOR STREET, 69 ft. of width used, R. R. tracks excluded.		SUPERIOR STREET VIADUCT. 42 ft. wide, two R. R. tracks included.	
	Week d'ys only.	Sundays included.	Week d'ys only.	Sundays included.	Week d'ys only.	Sundays included.
Tonnage of Vehicles	924	831	2901	2571	1564	
" " per ft. of width	22	20	42	37	37	
" Horses	1071	960	3098	2761	1556	
" " per ft. of width	26	22	45	40	37	
" Vehicles and Horses	1995	1781	5999	5332	3120	
" " " pr.ft.of width	48	42	87	77	74	

In obtaining the tonnage, light vehicles were estimated at an average of one-half ton each, including load; medium weight, 2 tons; heavy weight, 4 tons, and horses, one-half ton. Multiplying the total number of vehicles in each class by these figures and adding the products, the total vehicle tonnage was obtained; and dividing this by the width between curbs and the number of days of observation, we get the daily average vehicle tonnage per foot of width, the standard or unit of comparison. The horse tonnage was treated in a similar manner.

The instructions guiding the recorder were as follows:

Vehicles up to one ton:

One or two horse carriages, empty or loaded.
One horse wagons, empty or light loaded.
Two horse wagons, empty.
One horse carts, empty.

Vehicles from one to three tons:

One-horse wagon, heavy loaded.
One-horse carts, loaded.
Two-horse wagons, light-loaded.

Vehicles over three tons:

Wagons and trucks, drawn by two or more horses and heavy loaded.

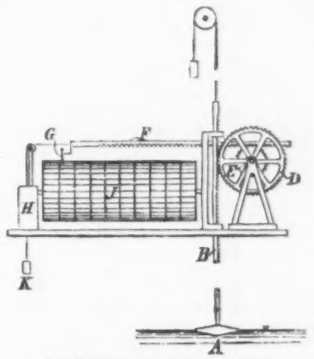
Note especially unusually heavy loads, such as 6-horse trucks loaded with stone or iron, and give estimate of weight. In checking vehicles, note separately, attached and unattached horses. All entries to be in groups according to gait, of walking, trotting or speeding. The local weather reports were used in connection with the final returns.

Of the three streets upon which the tonnage was noted, Euclid Avenue was paved in 1864 with "common" Medina sandstone, which is now worn and uneven, and in March, 1888, very dirty. With a population in Cleveland of 60,000 in 1864 and 230,000 in 1888, the total tonnage per foot of width, passing over this pavement, 142 ft. wide between curbs, since it was laid is estimated at 120,000 tons. Superior Street was paved in 1882 with "common" Medina sandstone; the street is ninety-two feet wide between curbs, but 24 ft. of the centre width is so-occupied by street railways as to exclude other traffic; hence the width used in obtaining an average is 69 ft. The pavement is now rough and uneven, and the street was very dirty at the time of observation. The total of vehicle tonnage per foot of width passing over this pavement since it was laid is estimated at 78,000 tons. The approaches to the Superior Street viaduct were paved in 1879 with "dressed block" and Medina sandstone, with asphalt cement filling. The carriage way is 42 ft wide, including a double track street railway. This pavement is cleaner than the average Cleveland pavement. There are some depressions due to uneven settlement, and the joints between blocks are somewhat worn to a V-shape. The total estimated tonnage over it since 1879 is 95,000 tons per foot of width.

With the conditions above stated the above tables give the results deduced.

A Simple, Automatic, Self Registering Tide Gauge.

The *Zeitschrift für Instrumentenkunde* (1887 p. 243) gives the following description of a very simple, automatic, self registering tide gauge which has been successfully used for a number of years in Germany.



Self Registering Tide Gauge.

The instrument consists of the float *A* (in the accompanying sketch) fixed to a rod having a vertical rack, which moves the wheel *D*. Upon the same spindle is a pinion *E*, which moves the rack *F* which has a pencil attached at *G* and is kept from losing motion by the weight *K*. The cylinder *J*, upon which a sheet of ruled paper is placed to receive the diagram is moved by the clockwork *H*, revolving once in 24 hours.

THE Nordenfeldt torpedo, which was tried in the Thames about two weeks ago, moves under water at a depth of 6 ft. and at the rate of 14½ knots an hour. Its motive power is stored electricity, and it can be worked from the shore readily and accurately. It is shaped like a cigar, 35 ft. long, and maximum diameter 29 ins. Its total weight when charged for action is 6300 lbs. Its charge is 300 lbs., which can be increased to 500 lbs. It carries an electric cable 3000 yds. long, which is paid out as the torpedo progresses. It is through this cable that the engine is operated, by means of a keyboard on shore. The trial was considered very successful.—*Montreal Star.*

The Manchester Ship Canal.

(*Continued from page 539*)

We proceed with the detailed description of this work, prefacing the account of the work on sections 4 and 5, given this week, with the statements made at the last meeting of the Canal Company relating to present state of the work. In order to fulfill the conditions of the contract and finish the work in four years, 100,000,000 cu. yds. of material must be excavated per month. In the first six months, the average excavation has slightly exceeded this amount; in May it was 1,030,423 cu. yds. The contractor intends to treble the force of men and very largely increase the plant during the next few months, and hopes to increase the monthly excavation to 2,000,000 cu. yds. There are at present in active employment upon the works 56 steam excavators, 73 locomotives, 2,367 wagons, 50 steam cranes, 79 miles of temporary railway, and 6,000 men.

SECTION NO. 4.

This division is 4½ miles long, extending from 11¾ miles to 16¼ miles; at the end of May 700 men were employed upon it. The engineering work of this section and also of a part of section No. 5, the whole division being 5½ miles in length, is attended to by the engineer and one assistant engineer. The land required for this section is 228 acres.

From 11¾ miles to 13½ miles the canal extends between the town of Runcorn and the estuary, altering entirely the existing connection between the Mersey and the large docks at the termini of the various canals. In some cases the present masonry will form the inner wall of the ship canal. At 12¾ miles the canal passes through one of the arches of the London & Northwestern Railway viaduct; and as the canal takes up the present deep water channel, another will have to be dredged, the estimated

quantities to be removed being 99,000 cu. yds. soft excavation and 23,100 cu. yds. rock.

"On section No. 4 there are in round numbers about 4¾ million cu. yds. of earthwork, of which it is estimated that about 600,000 cu. yds. will be rock. The main earthwork was started early in March last, and at the end of May, about half a million cubic yards had been excavated; previous to March preliminary work only had been carried on. The first work met with on this section is the surface sod stripping; this has been executed to the full width of the cuttings, from 13¾ in. onward. At 14 m. cutting No. 13, a steam navvy is at work in a 22 ft. face, and the gullet has been carried by an easy grade from the surface at 14¾ down to that point. At 14⅝ m. another navvy is at work in a deep face, and the cut which runs out to the surface about ¼ mile onward will be carried on parallel with the one just mentioned. Cutting No. 13 is one of the deepest on the canal; the bottom will be 67 ft. below the surface of the ground, the upper portion now being excavated by the navvies is a sandy clay, but the rock bottom is showing in places. At 14½ m. another navvy is at work in cutting No. 14. The stuff from these cuttings is being run to spoil to the river side of the canal at 15¼ m. This tip is particularly interesting. It is on a bed of peat dry and springy to walk over, but the spoil bank has sunk to a depth of quite 40 ft. in the peat, and the surface near the visible toe of the embankment is raised up like water from the bow wave of a steamer, and is, outside this rise, burst into huge fissures which are full of water; the whole body of this spoil bank, in some places 30 ft. or 40 ft. wide, has sunk as much as 9 ft. in one night—it is a very troublesome piece of work to keep in order. From 15¼ m. to 15¾ m. barrow work is being done in peat, too soft to bear the weight of an excavating machine.

At 16¼ miles shafts are being sunk preparatory to putting in a tunnel to carry the mains of the Liverpool water-works. Priestman clam-shell excavators are much used here, and for localities where the bottom is too soft to bear the weight of a steam excavator, these machines do excellent work from the surface. The Dunbar and Ruston 10 horse-power steam navvies used here are said to have made some astonishing records for ten hours' work. The buckets have a capacity of from 1½ to 2¼ cu. yds., and the cars have a water-level capacity of 4¼ cu. yds. With large buckets, 444 cars were loaded in one day, and the record with small buckets is 385. The cut is sandy clay, 22 ft. deep.

The main plant for section No. 4 consists of 8 locomotives, with cylinders 10 to 13 ins. in diameter; four Dunbar and Ruston steam navvies; three Priestman's clam-shell excavators with power equal to a three ton crane; 250 cars; 700 barrows; two 10-ton and 2 2½-ton steam traveling cranes; one 16 horse-power and one 12 horse-power portable engine; two centrifugal pumps, and pulsometers. There are 13 miles of temporary railway, and 14 barges of 60 tons capacity are used on the Mersey and Irwell canal, which the Manchester canal crosses from time to time, and which the company have purchased and will eventually abandon, it being now used for transporting supplies along the line.

SECTION No. 5.

This division is 4¼ miles in length, terminating at 16¼ miles. At the end of May the force consisted of 600 men and the usual supervising and engineering staff. About 497 acres of land will be required, and an additional 80 acres have been secured for possible future dock extension.

At 19¼ miles will be a branch from the canal, which branch, after extending for about ½ of a mile, will widen out into a basin about twice the canal width and half a mile long, constituting the Warrington Dock. As this branch follows the present bed of the Mersey, considerable river diversion, ⅞ of a mile long, will be necessary.

An important feature of this section is the change in railway alignment, (at three places.) Nos. 1 and 2 will cross on skew viaducts, with five main girders, built of steel, with span of 292 ft., giving on the square a clear waterway of 120 ft., and a clear headway above the water level of the canal of 75 ft. The bridge will carry four tracks, and, it is estimated, will require 46,425 cu. yds. masonry, 1,254 tons steel, 372 tons wrought-iron, 45 tons cast steel. A bridge over the Mersey will also be required for these roads; it will require 6,000 cu yds masonry, 339 tons steel, 36 tons wrought-iron and 10 tons cast steel. The third deviation will also cross on a skew viaduct; this will have three main steel girders, bow-string pattern, will carry two tracks and have span of 277 ft., giving a clear waterway on the square of 120 ft. and a clear headway of 75 ft. Estimated quantities are: masonry, 30,950 cu. yds.; steel, 651 tons; wrought-iron, 187 tons; cast steel, 20 tons. The gradient approaching these viaducts will be .008, and the embankments will be about 60 ft. high. The total excavation for them is estimated at 2,553,596 cu. yds., and 23 highway bridges will be required.

Upon this section there will be 6,750,000 cu. yds. of excavation, and it is thought that nearly 3,000,000 cu. yds. of this will be rock. The earthwork was begun in January, and about 500,000 cu. yds. have been taken out so far.

A Lübecker excavator is in use on this section. In external appearance it is like a house on wheels; with an opening in the center through which railway cars pass. The buckets are carried on an arm projecting 48 ft., this arm can be extended to 53 ft. when necessary. There are 25 buckets, each of about ¼ cu. yd. capacity.

"The machine is capable of excavating to a vertical depth 20 ft. below the rail level on which it runs. The weight unloaded is 50 tons; but about 12 tons of rails were fixed in the undercarriage, at the far side from the cutting, to counteract the tilting effect of the bucket ladder, The boiler is placed on the side away from the cutting, and the engine on an inclined frame is fixed overhead, and transmits motion to the bucket wheel shaft by a train of reducing gear. The engine has one pair of cylinders 8½ in. in diameter and 13-in. stroke. The engine shaft is driven at 180 revolutions, the second motion shaft 55 revolutions, and the bucket shaft 7.65 revolutions per minute. The engine is 35 H. P., and the working ing pressure 75 lbs. The machine requires a somewhat complicated arrangement of rails to travel on; an 18-ft. sleeper is necessary, laid to the number of 4,000 to the mile. Five rails are required for the road, three for the machine, and two for the ordinary wagon road. Of the former, one is laid near the outer end of the sleepers, and two 2 ft. 11½ in. apart, on the side of the cutting, the total gauge being 12 ft. 7-ins.; an intermediate pair of rails 4 ft. 8½ in. apart are laid so that the wagons can be run beneath the machine and loaded. About twelve buckets go to fill a truck."

The capacity of this machine is said to be 42 cars per hour in sand, and somewhat less in clay.

The temporary railway on this division required a great deal of work. It passes under two railways through their road bridges and over a piece of country road leased by the contractor.

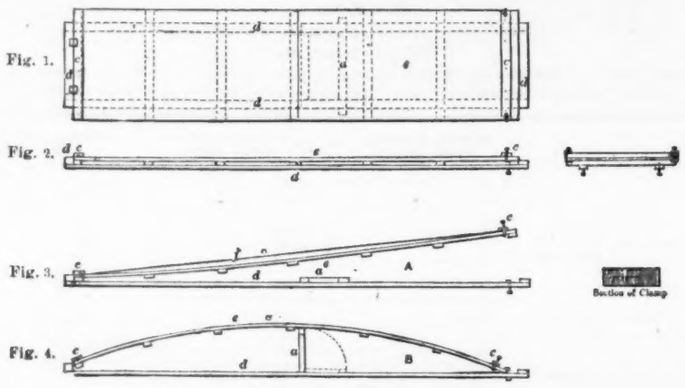
The main plant on the section consists of nine locomotives from 9-in. to 13-in. cylinders, four Dunbar and Ruston steam navvies, one Lübecker land-dredge excavator, 300 cars, 500 barrows, four 2½ ton and one 3-ton steam crane, five 10 H. P. and one 12 H. P. portable engines, four 6-in. Wade and Cherries' centrifugal pumps, and one pulsometer. There are nine miles of road and six miles of fencing constructed on the section. It is intended to increase both the plant and the number of hands employed on this length.

(TO BE CONTINUED.)

Large and Enlarged Photographs and Blue Prints.*

PROF. THURSTON referred to the large blue prints he had exhibited at a previous meeting, one of which was 8x3½ ft., which was made on a revolving cylinder, without glass. He then showed a print 14 ft. long and 2½ ft. wide, made on a still simpler apparatus originated by himself, which he describes as follows:

"The printing apparatus consists of nothing but a single thin board, of the length and breadth of the proposed print, with some margin for the stretching clamps. This board is covered with good felt of a carefully selected quality, securely and smoothly fastened to the board by any convenient means. A line of tacks around the edges does as well, perhaps, as anything. The sensitive paper is then stretched over the felt, and the tracing drawn over that, and both are smoothly stretched by clamps or other convenient device. It is of course evident that it would not be practicable by this operation simply to obtain that complete contact and pressure throughout the surface in contact that is required for good work; but this desideratum is easily secured by the simplest expedient imaginable: The board is merely sprung to a flat arc in the direction either of its length or of its breadth, ordinarily in the longer line. This brings everything "taut," and the printing is done precisely as under glass, with the further decided advantage that no light is lost through the intervention of the glass; which, however excellent in quality, will inevitably absorb a very measurable amount.



Apparatus for Making Large Blue Prints.

The accompaning sketch represents such an apparatus. Figs. 1 and 2 are a plan and side elevation of the board and its mounting. It will be seen that the upper, or printing board, is supported upon a lower and somewhat narrower and longer one, which, in turn, should be carried on trestles or other convenient arrangement. The printing board is stiffened laterally by strips or battens, but is free to spring longitudinally to any desired extent. The supporting board is stiffened longitudinally. At each end of the latter is a batten *dd*, set transversely, which answers as a check, as seen later. Clamps *cc* are placed at either end of the printing board by means of which to secure the felt, paper, and tracing. One or both of these clamps may be made adjustable for varying lengths of print. Figs. 3 and 4 show the method of operation. The board is first raised at one end and then slightly sprung. The felt and paper, and the tracing which forms the negative, are stretched smoothly between the clamps and well secured. The board is next laid down on the supporting base, the two ends made fast, the one to the batten at the left, the other to another arranged at the proper distance from the right hand extremity, the printing board springing into a curve of which the bridge *a*, hinged at the middle as in *A*, and thrown up as seen in the sketch *B*, gives the versed sine. By springing to any desirable extent as in *A*, and then reversing the curve as in *B*, any required degree of tension and stretch can be given the tracing, and thus any necessary amount of pressure and perfection of contact with the sensitive paper may be obtained. The two sections at the right, exhibit the end view of the pair of boards and a section of the clamp used.

It is obvious that there is almost no limit to the size of print that can be made by this method. The amount of springing necessary is small, never enough to cause a perceptible lack of uniformity in the tone of the print. If it should ever seem too great, this danger may be obviated by first springing the board in the opposite direction; then after securing the felt and paper, bending it a little past the straight line in the proposed direction.

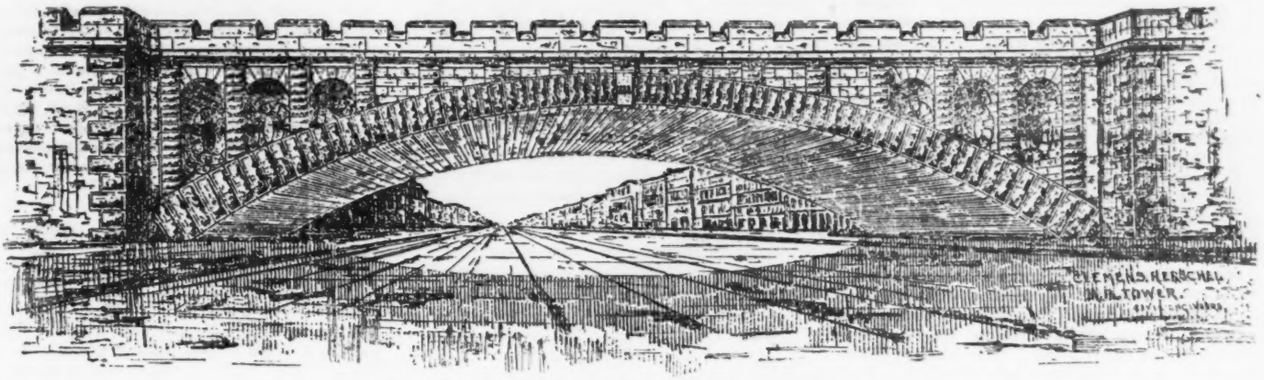
Prof. THURSTON alluded briefly to some recent experiment in enlarging photographs, and stated that such enlargements had been successfully made in sizes well adapted to the purposes of an instructor in making wall charts and maps, and in drawings of architectural subjects and machinery. Full page plates from the engineering journals, cabinet photographs and architectural drawings have been reproduced in photographs of 2½×3 ft., and 9×4 ft., at a cost well within the limit of availability. Such re-

*Abstract of Paper presented at the 17th Annual Meeting of the American Society of Mechanical Engineers.

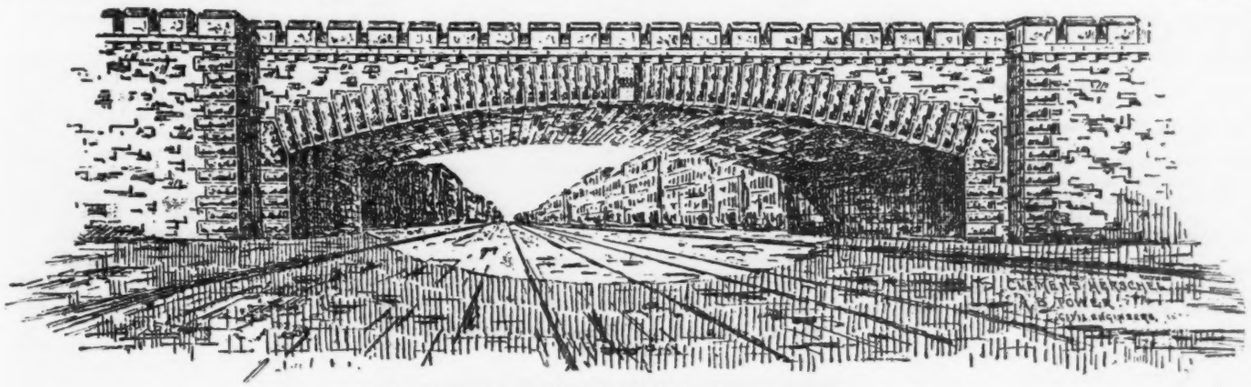
productions could not have been made economically by any of the older methods. They are clear and distinct in all details, the effect being particularly good in architectural subjects and complicated machinery.

The Proposed Stone Arch at Springfield, Mass.

In our issues of May 12 and June 2, we had something to say concerning the lack of good taste displayed in the proposed stone arch bridge at Springfield, Mass. Mr. CLEMENS HERSCHEL, Mem. Am. Soc. C. E., now comes out in a letter to the *Springfield Republican*, under date of July 21, with an argument in a similar vein, but made more effective by submitting two other designs for the proposed arch, either of which is immeasurably superior in appearance to the design of the Boston firm of architects. We reproduce these designs and republish our illustration of May 12, so that our readers may pass judgment for themselves.



Design "A" for Springfield Arch, by CLEMENS HERSCHEL, C. E.

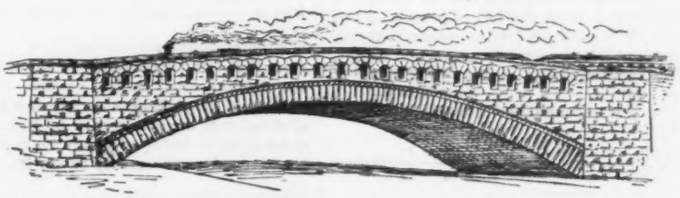


Design "B" for Springfield Arch, by CLEMENS HERSCHEL, C. E.

Mr. HERSCHEL accompanies his alternative plans with some very sensible remarks upon the design of stone bridges generally, and this bridge in particular. The first of these is, that the proper design of a bridge belongs rather to the province of trained and educated civil engineers, than to that of architects, and it is no reflection whatever upon the skill of the latter profession that possibly the first attempt of this firm at bridge designing should be crude. But in this case the homely appearance of the Springfield arch is not due wholly to a lack of skill in handling similar construction on the part of the architects; but it is enhanced and rendered doubly sore by unusual, cumbersome and senseless requirements of the contracting parties. Mr. HERSCHEL points out, and suggests amendment in, the clause of the decree which demands that the arch must be surmounted on either side by a stone wall or parapet not less than 12 ft. high above the track. This is expensive nonsense, and as the writer says, the worst of libels upon the "horse-sense of horses." No such shield was necessary to protect horses against the trains running for years on the previous grade crossing; none such are found on the numerous iron railway street bridges throughout the country, or on the miles of elevated structures in New York and other cities. Its only effect here is to obstruct the view of passengers, make them crawl a few steps higher in ascending to each train on account of the needless depth of arch crown called for in a stone structure, and to add greatly to the expense of the crossing by requiring stone where steel or iron would have answered every useful purpose.

It is this parapet requirement that probably accounts for the row of small arch-openings in the Boston design; but it does not account for the curving of the crowning coping, which in connection with the horizontal end abutments, constitutes a flagrant infraction of the canons of good taste in design. As peep-holes to the passengers these arches are valueless, as they appear to occur about on the level of the car-trucks; and as ventilators they are not needed in an open-top structure. And, as they are *not* ornamental, they simply add to the expense of the structure in a crude attempt to break the surface of an otherwise blank wall.

The designs of Mr. HERSCHEL are on the other hand massive and dignified as is befitting the material used and the purpose intended. That design giving ample headway at the springing of the arch is to be particularly commended in a place where all the width under the arch is supposed to be utilized by traffic. The springing of the arch from the ground line may save some abutment masonry, but it certainly necessitates also a useless length of span, and a certain width of sidewalk over which nothing higher than a cat can pass. The horizontal, castellated parapet wall is also a vast improvement upon the ugly curve and meaningless arches of the original plan. If Mr. HERSCHEL'S plans are submitted to a popular vote along with the Boston design, as he suggests, we have no doubt as to the ultimate result. If nothing but a stone arch will do for the Springfield authorities in this matter, and we do not object to stone arches, by all means let this arch be a credit to the good taste and common sense of all concerned, rather than a reproach to both.



Springfield Arch as Originally Designed.

The Growth of London.

When the population of England in 1801 was under 9,000,000 that of London was 958,863. The capital and the kingdom have grown together, but the former has always grown faster; so that, while England (including London) mounted from nearly 9,000,000 in 1801 to nearly 26,000,000 in 1881, London grew from 958,863 to 3,816,483 in 1881. London more than quadrupled its people, while England (including London) did not quite triple it; England (excluding London) advanced in a still smaller proportion; and it will be seen that England, excluding all its big towns, exhibits a still feebler advance. But note this point about London. Its limits increase. If we had a series of maps shaded so as to show the population we should see the black central spot of London getting bigger and bigger—the wen which COBBETT detested and denounced growing more and more portentous in size—but though the black spot grew bigger, yet its center grew lighter and lighter; and by the center is not meant that strictly limited area called the city, but something

more like what London was when the century began. Take, in fact, the area occupied by the mass of those 958,863 who constituted the population of London in 1801, and fewer persons will be found living upon it, while around it lies a widening ring, growing blacker as the center whitens. While, however, London has grown so enormously in population and in so great a proportion compared with the rest of the kingdom, its rate of increase has not been at all commensurate with that of many provincial towns, nor has it been equal to that of the towns of England as a whole. Speaking of these towns as a whole, it seems a fair estimate to say that of the 9,000,000 living in England and Wales in 1801, 3,000,000 lived in towns. This errs, if at all, in making the town population too large a proportion of the whole. Of the 26,000,000 of 1881 nearly 15,500,000 lived in towns; or, if we follow the Register General in ranking as townsmen all who live in urban sanitary districts, more than 17,500,000 were townsmen. The inhabitants of towns have increased at least fivefold; the inhabitants of the country at the most by 75 per cent. The town population was one-third of the whole; the Register General's calculation would make it two-thirds. Diverging for a moment from the proper order of inquiry, it may be remarked that this phenomenon of the relative increase of the town population is not confined to England. It may not have reached the same proportion of the whole in any other country, but it has grown at an even greater rate elsewhere. Two examples may suffice. In Norway the town population was 9 per cent. in 1801; this had grown to 18.1 per cent. in 1875, and it is now 22 per cent. In the United States the proportion was only 3.9 per cent. of the whole in 1800; it was 22.5 per cent. in 1880.—*The Nineteenth Century.*

Formula for the Computation of Railroad Earthwork.

The entire deduction of this new and origina formula depends upon the well known prismoidal formula, viz.:

$$V = \frac{l}{6}(B + B^1 + 4M) \text{ or,}$$

$$V = \frac{l}{6}\left[B + B^1 + 4\left(\frac{B+B^1}{2}\right)\right] = \frac{D}{2}(B + B^1)$$

in which D represents the length of a single section, B the area of one cross section, B^1 the area of the consecutive cross section, and M that of the middle cross-section $= \frac{(B+B^1)}{2}$.

Fig. 1 represents the cross section of a railroad cut (this formula applies, however, equally well in the case of fills, contrary signs being used) the

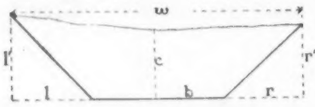


Fig. 1. Section of Cut.

letters denoting the following values. b = one-half of the width of road bed, r = horizontal distance from the right edge of road bed to slope stake, l = horizontal distance from the left edge of road bed to slope stake; r^1 and l^1 are corresponding distances on the right and left respectively. c = center height, w = width between slope stakes; S = ratio of slope $= \frac{r^1}{r} = \frac{l^1}{l} = \frac{1}{1}$ for cut and ½ for fill, generally.

Therefore $B = wr^1 - \frac{1}{2}(r^1 - l^1)w - \frac{ll^1}{2} - \frac{rr^1}{2}$ from geometrical considerations.

$$\text{or} = \frac{wr^1}{2} + \frac{wl^1}{2} - \frac{ll^1}{2} - \frac{rr^1}{2}.$$

$$= \frac{w(r^1 + l^1) - (ll^1 + rr^1)}{2};$$

but since $r^1 = Sr$, and $l^1 = Sl$,

$$B = \frac{wSr + wSl - Sl^2 - Sr^2}{2} = \frac{Sr(w-r) + Sl(w-l)}{2}$$

But $w - r = 2b + l$, and $w - l = 2b + r$. Therefore $B = Sbr + Srl + Sbl = Srl + Sb(r+l)$.

Now suppose r and l to represent corresponding quantities at the next cross section whose area is B'; similarly $B' = Sr_1l_1 + Sb(r_1 + l_1)$ and $B'' = Sr_2l_2 + Sb(r_2 + l_2)$; and finally, $B^n = Sr_nl_n + Sb(r_n + l_n)$.

Now substitute in the original equation for V and the result is,

$$\text{Volume} = \frac{D}{2}\left\{Srl + Sb(r+l) + Sr_1l_1 + Sb(r_1 + l_1)\right\}$$

or

$$V = \frac{D}{2}\left\{S(rl + r_1l_1) + Sb(r + r_1 + l + l_1)\right\},$$

hence the total volume of any number of successive sections is:—

$$\text{Volume} = D\left\{\begin{matrix} S\left(\frac{rl}{2} + r_1l_1 + r_2l_2 + \ldots\ldots + \frac{r_nl_n}{2}\right) \\ + Sb\left(\frac{r+l}{2}\right) + \left(r_1 + l\right) \ldots + \frac{r_n + l_n}{2}\end{matrix}\right\}$$

This formula is thus expressed:

$$\text{Vol} = D\left\{\begin{matrix} S \text{ (product of intermediate } r\text{'s and } l\text{'s, } + \tfrac{1}{2} \text{ (product of end } r\text{'s and } l\text{'s)} \\ + Sb \text{ (sum of intermediate } r\text{'s and } l\text{'s)} \\ + \tfrac{1}{2} \text{ sum of end } r\text{'s and } l\text{'s}\end{matrix}\right\}$$

This formula has also a graphical representation which obviates all multiplication and facilitates the process of computation depending upon that well

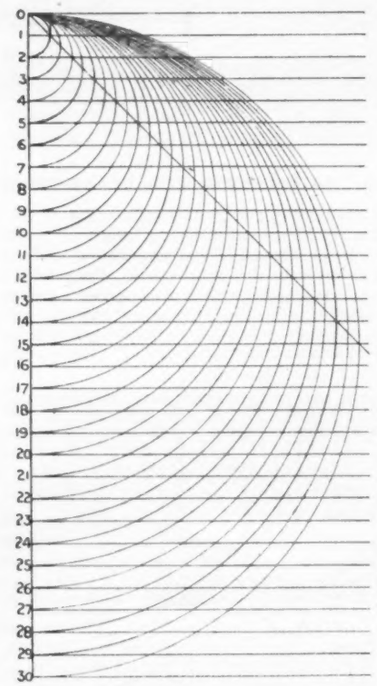


Fig. 2. Diagram for Computing Earthwork Graphically.

known proposition: If the diameter of a circle be divided into two segments and a perpendicular be erected from the point of division to a point on the circle, that perpendicular will be a mean proportional between the segments of the diameter. The application is thus made: Suppose r and l to be two segments of a diameter of a circle whose radius will be $\frac{r+l}{2}$; therefore, by the above proposition, if x represent the perpendicular, $x^2 = rl$. It is thus seen that the single terms in the first member of the general equation for volume, represents the squares of the perpendiculars drawn from the point of division of the diameter $r+l$: Hence as in Fig. 2, draw a line 0—30, lay off to any convenient scale consecutive units of length up to any limit. With 0 as a common point and center for all values of $\frac{r+l}{2}$, draw circles and at each point of division of the r's and l's draw ordinates. Now when any value of rl is wanted, it will be given by scaling the ordinate through the point of division of the r and l to where it cuts the circle drawn with a radius of $\frac{r+l}{2}$. Then this value of the ordinate must be squared and for the first and last terms, must be divided by 2. For convenience this diagram should be made on a large scale and the values of the squares of all the ordinates written at the point of intersection of circles and ordinates.

Water Charges, by Measure and Assessment.

Water is supplied by private companies or public bodies for two different uses; (1) domestic, (2) trade. It is not always possible to draw the line rigidly, as some supplies to the same premises are partly trade and partly domestic.

It is absolutely necessary for the health of a community that they should have a plentiful supply of good water at a reasonable price placed within the reach of every member.

It is proposed to take, as an example, a town of 50,000 persons, and to consider the question of supply by measure and assessment. In order to arrive at the cost of the water per 1,000 galls., the prime cost of the works, interest on and repayment of capital and the working expenses must be known.

Assuming then a population of 50,000, let these items be estimated (1) on the principle of the works costing 1*l.* per head of the population (2) costing 2*l.*, (3) costing 3 *l.* The first sum is very low, the third rather high.

Population, 50,000.	£	£	£
Capital expended	50,000	100,000	150,000
Interest at 4 per cent.	2,000	4,000	6,000
Sinking fund	325	650	975
Working expenses	3,300	3,300	3,300
Annual expenditure	5,625	7,950	10,275

A supply of 20 galls. per head daily, or 1,000,000 galls. for 10,000 houses, taking five persons to a house, is the quantity assumed to be necessary, and will thus cost for each house yearly either 11*s.* 3*d.*, 15*s.* 10*d.*, or 20*s.* 6*d.*, according to the cost of the works.

In making this calculation interest has been taken at 4 per cent. and repayment of capital at 4 per cent. compound interest as by Inwood's tables, page 155, for 50 years. The working expenditure includes salaries, wages, coal for pumping, rates, taxes, etc., in fact, all the necessary expenses on the revenue side taken from the towns within author's own experience. As the cost of 1*l.* per head is very low and 3*l.* per head very high, let the example of 2*l.* be more fully considered.

The quantity of water supplied per house for 15*s.* 10*d.* per annum is assumed to be $20 \times 6 \times 365 =$ 36,500 galls., each 1,000 galls. being thus about 5¼*d.* The weekly charge per house is 3⅜*d.* In order to provide a small balance of revenue, the charge for water would probably be 6*d.* per 1,000 galls., a little over 4*d.* per house weekly, or 17*s.* 7*d.* per annum.

A manufacturing town of 50,000 population, inhabiting 10,000 houses, may be taken to contain about the following at the various rentals:

Annual Rental.	Number of Houses
Under 5*l.*	200
5*l.* and under 10*l.*	3800
10*l.* " 15*l.*	4000
15*l.* " 20*l.*	800
20*l.* " 25*l.*	300
25*l.* " 30*l.*	200
30*l.* " 35*l.*	150
35*l.* " 40*l.*	150
40*l.* " 50*l.*	150
50*l.* " 60*l.*	150
60*l.* " 70*l.*	50
70*l.* " 80*l.*	50
Over 80*l.*	200
	10,000

These figures are taken from an actual example but reduced to the nearest level number under each rental.

The water rate as usually charged is about 4 per cent. on the rental value and approximately the rates payable by each house in the foregoing example would be as follows, taking jumps of 4*l.* up to 40*l.* and then of 10*l.*:

Ann. rental.	Annual water rate at 4 per cent.	Annual water rate by meter.	Excess by m'ter rate.	Excess by Assessment.
£.	£. s. d.	s. d.	s. d.	£ s. d.
4	0 3 2	17 7	14 5	
8	0 6 4	17 7	11 3	
12	0 9 7	17 7	8 0	
16	0 12 10	17 7	4 9	
20	0 16 0	17 7	1 7	
24	0 19 3	17 7	.....	0 1 8
28	1 2 5	17 7	.....	0 4 10
32	1 5 8	17 7	.....	0 8 1
36	1 8 9	17 7	.....	0 11 2
40	1 12 0	17 7	.....	0 14 5
50	2 0 0	17 7	.....	1 2 5
60	2 8 0	17 7	.....	1 11 5
70	2 16 0	17 7	.....	1 18 5
80	3 4 0	17 7	.....	2 6 5
90	3 12 0	17 7	.....	2 14 5
100	4 0 0	17 7	.....	3 2 5

It will be noticed that the scales cross between 20*l.* and 24*l.*, so that about 8,900 out of 10,000 houses would have to pay more for water by meter than by assessment.

If it should be considered advisable to charge by measure for domestic supplies, it is necessary to frame some clause which shall meet this difficulty such as the following: A charge of 6*s.* per annum payable quarterly shall cover a consumption of 6,000 galls. per quarter, all used in excess of this quantity shall be charged at the rate of 1*s.* per 1000 galls. How such a method would operate it is hard to say; in the hands of a public body with the power to levy a rate in aid it might answer, but certainly not in the hands of a company. Although nothing has been said on the mechanical aspect of the question it presents great difficulties, for the meter to fulfil the needful conditions is not yet made.

It should (1) be positive in its action; (2) not liable to damage by frost; (3) compact; (4) not expensive; (5) easily read; (6) easily repaired; (7) not requiring constant attention; (8) noiseless. Without wishing to enter upon the merits and demerits of the numerous meters before the public, it may safely be said that not one completely fulfills half the above requirements.

There are many other difficulties in the way of largely augmenting the number of meters to provide them for domestic use, such as the increased capital to purchase and set them, the staff to keep them in order, and the constant disputes they would lead to, and on the whole there is no fairer mode of charge than the basis of rent, the percentage decreasing as the rent increases.

As for supply by measure for trade purposes, this is a matter upon which there can be but little said; it is obvious that a person desiring for business purposes a large or uncertain quantity must be supplied generally speaking according to the quantity. In a domestic supply with proper fittings and inspection there is not great waste unless from carelessness, and then in comparatively few instances, hence the quantity is known within certain limits; but in a trade supply the reverse is the case and an instrument to measure the quantity is necessary. As a rule, a low-pressure meter supplying a tank or tanks at the top of the premises is the most reliable, but it often becomes necessary to use high-pressure meters. In using such, the principal points to consider are: 1. What the consumption will be when most water is being used and supply a meter to suit this; but the rule to keep the meter as small as is consistent with an efficient supply is not to be neglected, as large meters are of course more apt to cease to register with a small flow than small ones. 2. The meter should be protected from frost and danger of breakage. 3. It should not be exposed to fine dust or chemical fumes. When fixed, meters should be read every half-quarter, and if of the Kennedy type, oiled at the same time. If care is exercised and the successive readings compared, it soon becomes evident when a meter is inaccurate

There remains the quasi-domestic supply in which are included gardens, carriage washing, and tradesmen's shops usually associated with a dwelling-house. Now it is somewhat difficult to lay down any rule for these, but it may be said that certain trades should have a meter supply, especially brewers, dyers, photographers, and those who may use large quantities of water, while others may be charged a rate, care being taken that they are not allowed facilities for wasting. For gardens or carriages a rate is advisable, excepting a hose pipe is used, and then a meter should be insisted on; also

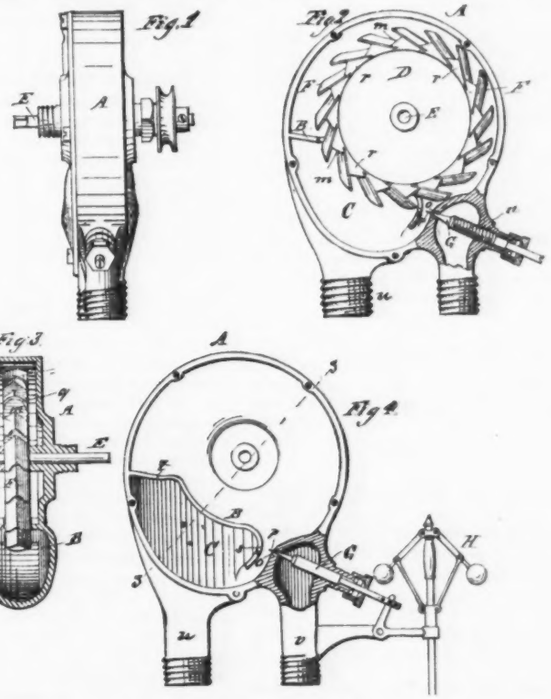
Number of Gallons.	One Shilling.	One Shilling and Three p'e	One Shilling and Sixpence.
	£ s. d.	£ s. d.	£ s. d.
1,000	0 1 0	0 1 3	0 1 6
5,000	0 4 3	0 5 4	0 6 4
10,000	0 7 11	0 9 11	0 11 11
20,000	0 14 10	0 18 6	1 2 3
50,000	1 13 10	2 2 3	2 10 9
100,000	3 3 1	3 18 10	4 14 7
1,000,000	25 1 2	31 8 0	37 13 6

in the case of large public institutions such as hospitals, jails, schools, and workhouses, where great waste is often found.

A scale for water supplied by measure is found by the logarithmic formula $V = a\ g^{\frac{5}{12}}$, where V is the price of g thousands of gallons at the initial or starting price for the first thousand gallons of a expressed in shillings and decimal of a shilling. Thus the preceding table gives examples of the charge on scales of one shilling = 1.00, one and threepence = 1.25, and one and sixpence = 1.5 as starting prices. *Engineering.*

A New Water Governor, or Regulator.

Water power as supplied from city mains to various types of motors is one of the most readily applied of all light forms of power, and of endless application to domestic and manufacturing purposes. But water under pressure costs money, and unless means exist to adjust this power automatically to the work in hand, waste is very likely to follow, and the power becomes too expensive for the service performed. This lack of regulation has been in the past one of the prime factors in discouraging the use of small water motors, and in so much depriv-



The Tuerk Water Governor.

in gpurvayors of water of what should be a very profitable source of income, when the cost of pumpage and the rental value of water for small motors are contrasted.

The device herewith illustrated is claimed to be the first thoroughly successful and scientific application of an automatic governor attachment to a water motor of types under 10-horse power, and it is given mainly in answer to enquiries for some such attachment. In the cut, Figs. 2 and 4 show how this throttling is accomplished in connection with a ball governor run by a belt in the usual way from the power-shaft. The principle involved is a maintenance of the full head of water. But through the centre of the entrance opening *O*, by which the water from the house main strikes the bucket wheel, passes a conical stem *G*, which is automatically thrust forward or withdrawn as called for by the speed of the governor. This action increases or reduces the area of the annular space about the stem and simply affects the quantity of water striking the buckets without any resulting loss of pressure or velocity in the supply. As the water is crowding into this space from all sides of the pin at once, the slightly conical form of this member results in the projections of a solid jet of water upon the buckets, a jet striking with the full force of the pressure head and in a condition to perform the most efficient and yet economical work.

While new, this regulator has been most satisfactorily applied to hydraulic motors of as much as 10 horse-power, and shows an instantaneous action in any variation of power required, at once cutting down and thus saving in the consumption of water. Any parties further interested in this matter should address the Tuerk Hydraulic Power Co., of 12 Cortlandt St., New York City.

ENGINEERING NEWS.

THE worst railway accident of the week was a head collision on the Norfolk & Western Railroad, near Lynchburg, Va., July 22. A gravel train was side-tracked to let three west-bound trains pass; but when two west-bound and one east-bound train had passed, the train pulled out and had just got up speed when it was run into by a local freight train, running about 35 miles an hour. The two engines and seven cars were wrecked. Thirteen men were killed. The coroner's jury found the company guilty of neglect in sending complicated orders not easily understood by the employes, and for its failure to designate engine No. 3, which would have prevented the collision. They were of opinion that the company should be held responsible.

THE following bridge accidents are reported: On July 19 the Buffalo Creek bridge of the Pittsburg, Cincinnati & St. Louis R. R. at Wellsburg, O., was damaged by the flood, the abutments being undermined. Trestling in the same neighborhood was also damaged.—On July 22 a Baltimore & Ohio freight train jumped the track on a trestle 20 ft. high and went down; two men were injured.

DURING the week there have been very heavy rainstorms in Pennsylvania and Ohio; the Ohio river has overflowed, and much damage has been done and many lives lost. Washouts have occurred on the Baltimore & Ohio; Pittsburg, Cincinnati & St. Louis; Ohio River; Bellaire & St. Clairsville, and St. Clairsville & Northern railroads.

THE new steamboat *Puritan* which is to run on the Old Colony Steamboat line from New York City to Fall River, Mass., was launched at Roach's shipyard, Chester, Pa., on July 25. She is 420 ft. over all, 404 ft. on the water line, 52 ft. beam, 91 ft. breadth above guards, 20¼ ft. hold, 63 ft. height of dome from floor, and draught of water, 12 ft.; gross tonnage, 4,650 tons; estimated displacement, 4,300 tons. She will be propelled by vertical beam engines of the compound type. The low-pressure cylinder will have 110 ins. diameter and 14 ft. stroke and the high-pressure one will be 75 ins. in diameter and 9 ft. stroke. There will be eight steel return-tubular

boilers with 7,000 H. P. She is expected to develop a speed of 21 miles per hour. Her hull is of steel, built on the longitudinal and bracket-plate system of naval architecture. She has 56 water-tight compartments and 6 water-tight bulkheads.

THE indubitable proof that members and prominent officers of the Brotherhood of Locomotive Engineers have been concerned in the attempts to injure the C. B. & Q. Co.'s property by dynamite and other destructive agents, have placed the organization in most unenviable light. The truth probably is, however, that the great majority of the men who compose the organization are peaceable, law abiding citizens, opposed to all acts of this sort, and that it is a small minority of hot headed and unprincipled men who have brought the brotherhood into disgrace. A conference between prominent officials of the Burlington company and of the brotherhood did not succeed in effecting any agreement for the close of the strike; but it is not probable that the brotherhood will tax itself much longer to pay wages to over a thousand idle men.

AUSTRALIA is extensively using wrought-iron water pipe, and 2,166 tons have just been bought at $78.44 per ton for the Watts river scheme. These pipes are partly 53-in., but chiefly 50-in. in diameter, and are to be used in carrying the water over the beds of creeks. It is estimated that in carrying out this scheme the Victorian government will save about $500,000 by using wrought instead of cast-iron pipe.

THE city of Paris has 30 miles of pipe laid for the distribution of power by compressed air, with compressing engines of 300 H. P., and about 3,000,000 cu. ft. of air are compressed daily to a pressure of 80 lbs. per sq. in. at an expenditure of 50 tons of coal.

A SWISS engineer proposes to eclipse all previous records by supplying water to Paris from Lake Neuchatel, a distance of 312 miles, 22 miles of which would be in tunnel. The lake is 1620 ft. above the average level of Paris streets; but as he estimates the cost at $100,000,000, there is no immediate chance for contractors.

WE have received from Mr. GEORGE H. COOK, State Geologist of New Jersey, the map of New Jersey on a scale of 5 miles to the inch. This map sums up on one sheet so much of the detail maps as can be included in this scale; showing 50 ft. contours generally and the geology, waters, railways, main towns, etc., in the State. In execution it is in full accord with preceding maps, and finishes the best set of State maps ever issued in this country.

A SUBMARINE cable across the Pacific from British Columbia to Australia, touching the Fiji Islands and the northern coast of New Zealand and connecting at the American end with the Canadian Pacific line, is seriously talked of. It is announeed that the *Egeria* will be used in making a survey which is to cover an expanse of water 200 miles in width for the entire distance of more than 7,500 miles, and which will require at least three years for its completion. A mail service between England and Australia, *via* Montreal and Vancouver, is also being considered.

THE attempt of the Metropolitan Railway Company, of London, to use electric locomotives, which, it is announced, will be first made in October or November next, will be watched with great interest by engineers all over the world, as the prospects of electric traction for the next few years depend very largely upon the success or failure of this scheme. Several locomotives are now being constructed, which are rated at 600 horse power. They will be operated with secondary batteries. This system is convenient for experimental work, but has many disadvantages in actual service. It is generally felt that the use of secondary batteries will increase the cost of operation and the chances of disaster and failure.

THE Steel Car Company is said to be constructing a fire-proof steel car at Boston, which will contain nothing that can burn except the upholstery, and even that is largely constructed of uninflammable material. Not only immunity from fire, but an increase in strength, a decrease in the liability to telescope, and diminished dead weight are expected to be some of the good features of the new car. The car now being built will contain an observation room, parlor, smoking room, buffet, etc., and promises to be as handsome as those finished in wood.

There is a rumor afloat that a canal is being planned to begin at Fano and extend across Italy, connecting the Adriatic and Mediterranean seas.

IT is reported that the Prussian State Railway management has decided to heat all carriages on the main lines by steam, which is to be furnished by a special boiler. In this system the passengers can regulate the heat by means of a lever placed in each carriage.

THE new Inman steamship, the *City of New York*, soon to enter this port on her maiden trip, is the largest passenger steamer afloat, having accomodations for 2,000 persons, 479 of these being first-class. Her gross tonnage is 10,500 tons and triple-expansion engines of 20,000 horse-power drive her independent twin screws.

ACCORDING to English papers the *Great Eastern* is to be docked at Barrow, and the work of dismantling her commenced It is suggested that she may be finally fitted with new machinery, and either employed in the cattle trade or used for transporting petroleum in bulk. A later statement says that the dock authorities at Barrow have forbidden the docking of the ship at that place. It might be money in some one's pocket to send this unfortunate ship to sea, and sink her there.

THE 25th quarterly report on the progress of the Forth Bridge is published under date of May 31. At the South Queensferry Pier the cantilevers are built out about 250 ft. from the skewbacks with corresponding work on the ties, braces, internal viaduct, etc. At Inch Garvie Pier the bottom members of the cantilevers extend out about 180 ft. beyond the skewbacks, and at the North Queensferry Pier the cantilevers extend in a similar manner 200 ft. The riveted work at South Queensferry amounted to 7,225 tons; at Inch Garvie to 8,370 tons, and at North Queensferry to 7,390 tons. This amounts in total to 22,985 tons of riveted work, or 3,856 tons set up during the quarter. At the date given, 572,880 cu. ft. of granite masonry had been set, and about 112,030 cu. yds. of rubble and concrete masonry built. The average number of men employed per diem during the quarter was 2,909. Gen. HUTCHINSON reports the work of the same high class as before, and no fatal accidents during the quarter.

HOW THE SOLOMON ISLANDERS MAKE FIRE.—The native method of producing fire is by the friction of a small, dry, pointed wooden stick on the smooth surface of another piece of wood, "which friction, in some three or four minutes, produces smoke, and, finally, a fine powder, which has been collecting in the small hole at the end of the groove, made by the rubbing of the stick,) begins to smolder. After being carefully nursed by the breath of the operator the tiny flame is transferred to a piece of touchwood, and the object is obtained." This primitive method is, however, fast giving way and dying out, owing to the competition of lucifer matches which the traders now supply. Torches are used by the natives of Bougainville Straits during their fishing excursions at night and during festivals. They are made of a resin which seems to be abundant, which has a powerful odor, and which is used by simply wrapping it compactly, after it has been powdered, in a palm leaf, which, although outside the resin, answers the purpose of a wick.—*The Westminster Review.*

CORRESPONDENCE.

A Correction.

NEW YORK, July 25, 1888.

EDITOR ENGINEERING NEWS:

Referring to the letter of Mr. H. IRVIN, printed in your issue of July 21, I will state that Mr. IRVIN is correct in thinking that he has discovered two misprints in my equations for calculating the profile of a masonry dam, which were given in your journal on February 4 and 11, of this year. You are not responsible for these errors, as the misprint in equation *b* occurs in the original report of Mr. FTELEY. As regards the second misprint the minus sign in the expression $l^2\left(h-\frac{p^1}{2}\right)$ almost joins the fraction sign in the original report, and led thus to your giving that expression as $l^2\left(h\,\frac{p^1}{2}\right)$.

Respectfully, E. WEGMANN, Jr.

Anthracite vs.: Bituminous Coal for Locomotives.

MAYWOOD, Ill., July 16, 1888.

EDITOR ENGINEERING NEWS:

Can you or any of your readers inform me on what roads anthracite coal is used as a fuel for passenger locomotives? Also can you give from reports of Superintendents of motive power, the quantity used by each road per annum; also its efficiency as compared with bituminous coal ton for ton; also cost per ton in the Pennsylvania coal regions of both anthracite and bituminous coal to railroad company. And oblige, respectfully, W. J. Y.

[We have not the data at hand to answer the rather broad questions of our correspondent. But some of our readers may possibly refer him to a better source of information.—ED. ENG. NEWS.

Long Timbers on Short Cars.

NEWPORT NEWS, Va., July 16, 1888.

EDITOR ENGINEERING NEWS:

In your editorial correspondence in issue of June 20, is a note respecting the utilization of short four wheeled cars for transporting 60 ft. sticks of timber. This simply shows that necessity leads different minds to the same conclusions. About 15 years ago I transported the four 23-ton anchor plates from the pier on the East river to the New York anchorage of the East River Bridge in the same way. Bolsters were fitted to the centers of two cars, turning on 2-in. iron pins, with a strap from the top of pin to the front of car to prevent bending. Two heavy sticks were bolted to ends of these cross bolsters, of sufficient length to allow of turning shortest curves without cramping. The plate was then jacked up, and suspended between the cars to these, by four hook bolts, catching under the flanges, and screwed up firmly by passing through the timbers with nuts and washers above. One curve of 17 ft. radius, 1 of 34 ft., and several others were passed safely, and the time of transport over about 1,000 ft. distance averaged about 2½ minutes. Yours truly,

F. COLLINGWOOD.

A One-Sided Level.

CORNWALL, Ont., July 16, 1888.

EDITOR ENGINEERING NEWS:

It has always been taken by me as an undisputed fact that in leveling, no matter how much the instrument is out of adjustment, if you set up midway between two turning points and level your instrument each time you sight, that the result will be the difference in level of the two points. Now I wish to take exception to this, or rather to add an important clause, and one which I have never yet seen in print; viz.—"And always stand on the same side of the bubble tube when leveling the instrument"; that is, mark one side of the bubble tube and never look at the other.

I had some leveling to do with a strange instrument last week, staked out my turning points with one midway between them for the instrument. All went well till I came to check back over my work and compare levels of turning points going and coming back. I never saw such an up and down affair and of course could not see any reason for it. I went over it all again with a similar result.

Something prompted me once, after leveling the instrument, to see how it looked from the other side

and ends. I saw the reason then. Perfectly level looking from one side and away out from the other. I had not taken any trouble before this to read from the same side of the tube, merely reversing after a back-sight standing where I was, and consequently bringing the opposite side of the tube around and leveling from this for the fore-sight. After finding out what was wrong, I had no further trouble. I have since tried to get rid of this peculiarity of the instrument without success, and have now a one-sided instrument to work with, which is not pleasant.

If you, or any of your readers, will give me some information on this point, you will confer a favor. The instrument is a Gurley with a divided bar over the bubble tube. YOUNG LEVELER.

[We can only account in two ways for the behavior of the "strange instrument" of our correspondent. Let him carefully compare the graduation of the two sides of the bar over his level tube. It sometimes, though rarely, happens that an error has been made in the center-mark, or there may be one unit more on one side than on the other. The second explanation would be the use in his instrument of a common bent glass bubble tube; an unground tube, and hence liable to some error in reading due to irregularity in the inner diameters. This last explanation, or in fact the first, hardly accords with the reputable name given as the maker of the level, but it is just possible that the instrument has been "repaired" at some time in its existence. The best thing to be done with it is to ship it to an instrument-maker who understands his business, and have its "one-sided" ailment doctored. This is an uncommon complaint; and while it is well enough to examine closely into the tricks of any new instrument, it is not absolutely essential to supplement the rules of leveling to the extent suggested above.—ED. ENG. NEWS.]

Metric Standards in the United States.

SCRANTON, Pa., July 23, 1888.

EDITOR ENGINEERING NEWS:

Referring to Mr. APPLETON'S communication in your last week's issue, I venture to express the hope that the day is far distant when an American legislator shall present a bill so un-American in spirit, as one to render a new system of weights and measures *obligatory*, after its optional use has been rejected. To *legalize* such a system is all that should be done for it in America, and if conferring a legal existence upon it, backed by the efforts of two or more societies established for its propogation, fails to introduce its use, I think that that should end the matter as far as legislative enactments go.

I grant that a universal system would be an advantage, and if, when France was looking for a new standard of length, she had simply adopted the English yard instead of a somewhat rough approximation to a certain fraction of the earth's polar circumference, one great step would have been taken. It would then have only been necessary to slightly change the English pound, so as to make it exactly half a kilogramme, and the quart, both English and American, so that it should be exactly one litre; and as regards currency to so modify it that the pound sterling should be exactly five dollars and the dollar five francs, in order to have, practically, one standard established in England, France and America.

But, waiving the benefits of an universal system, which are independent, in so far of the system itself, what are the great advantages which the metric system, *per se*, offers? As regards engineering linear measurements, the change would be only equivalent to using the yard, divided decimally instead of the foot, divided decimally. I do not see that there is anything more in it, from an engineering point of view, than this.

For small measurements, the *two foot rule* stands unrivaled. Compared to the *double décimètre*, it is as the violin to a jew's harp! It is the happy medium, the connecting link, between the very large and the very small. It is just about right. Its duodecimal divisions give us even twelfths, sixths, quarters, thirds, halves, two-thirds, and three-quarters, as against tenths, fifths, quarters, halves and three-quarters only; the thirds and two-thirds being particularly useful. When we go below the foot, we change the unit to the inch, and this change of unit, when we change from large magnitudes to small, or *vice versa*, instead of being a confusing complication, is a practical benefit of great value, devised to accommodate man's daily needs, and not to square with scientific abstractions. Again, the subdivisions of the inch enable us to draw plans very conveniently to scale; thus, we can lay out work to three-quarters of an inch, inch and a half and three inches to the foot, and take off even inches from the draft. The *double décimètre* is no doubt *simpler*, but a simple tool is not, thereby necessarily, a better one. To return to my original simile, the jew's harp is simpler of construction than the violin, but it is not, therefore, a more perfect musical instrument. Indeed it would take larger space than I would venture to ask for, to enumerate the many advantages of this queen of pocket measures, but, Mr. Editor, the more you think of it, the more you will realize that the foot-and-inch system embodied in, and applied to objects conveniently reached by, the two foot rule, exactly meets the wants of a practical nation like our own. G.

Heavy Rainfall.

PROVIDENCE, R. I., July 23, 1888.

EDITOR ENGINEERING NEWS:

As a number of your readers seem to be taking an interest in excessive rainfalls, the following may be of interest.

The meteorological records of the City Engineers' Office in Providence, show that on the afternoon of Aug. 6, 1878, 4.49 ins. of rain fell in one hour in Providence (one hour being the entire duration of the storm.) 3½-ins. of this amount fell in 36 minutes, which is equivalent to a rate of 5.83 ins. per hour. E. B. W.

Ice Thrust.

KANSAS CITY, Mo., July 20, 1888.

EDITOR ENGINEERING NEWS:

Some data from the St. Lawrence river may be of service in the discussion of this question.

The writer has noticed one detached portion of a sandstone ledge, resting upon an irregular nearly level sandstone floor, which has been moved some 20 ft. or more from the parent ledge by no other explainable cause than the pressure of ice in the crevice. The block, nearly rectangular, weighs perhaps a thousand tons, and the section of ice behind it may have been at times from 40 to 60 sq. ft. (edge of the ice). The ice in the river channel before it breaks up in the spring varies, in different seasons and places, from 12 to 24 ins., in thickness. The first movement is a crippling of the ice lengthwise of the river, generally following the channel line as the ice there is thinnest. This is made by about three nearly parallel cracks, the center one rising or falling, generally the latter, crushing in places but not to a great extent. The movement seems to be roughly an expansion of 1 to 2 ft. per mile of breadth and there is comparatively little disturbance in lines crossing the stream, in cold weather the ice shrinks—the cracks in large fields sometimes opening a foot or more, the noise resembling heavy rolling thunder. It will be safer to cut away the ice at the Quaker Bridge dam than to trust anything that man can build there to hold it.

Respectfully, G. W. PEARSONS.

A Hydraulic Conundrum.

PHILADELPHIA, June 28, 1888.

EDITOR ENGINEERING NEWS:

In your issue of June 23 "G" seems to have somewhat complicated "A B C's 'Hydraulic Conundrum'", which is, simply:

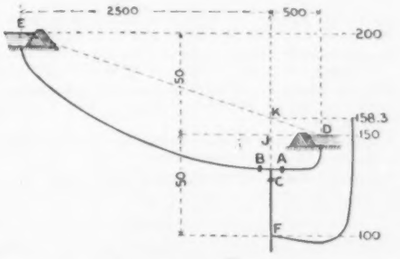
"Suppose the main leading to the city closed by a gate at *F*, and gates *A*, *B* and *C* all opened: All the mains shown would be filled and water would flow from reservoir *E* to *D*,—what would be the pressure shown by gauge at *F* under these conditions? Would it be more than 65 lbs. per sq. in.? and if so, how much?"

We may here remark that "A B C" seems a little incoherent as to his static heads and pressures, as the following table shows:

		Elevation, in feet.		Static pressure at *F*, in pounds per square inch.	
		Above datum.	Above *F*.	As calculated by "X Y Z." (=.434 × elevation above *F*.)	As stated by "A B C".
"A B C's" diagram.	*E*	200	100	43.4	87
	D	150	50	21.7	65
	F	100	0		
"A B C's" actual.	*E*	250	250	108.5	87
	D	150	150	65.1	65
	F	0	0		

Taking the figures in "A B C's" diagram, and in his first paragraph, we find that under the conditions stated by him the height of the hydraulic grade line above datum at junction (neglecting the entry and velocity heads, as "G" has done,) is 158.33 ft., as "G" states.

In other words, let the accompanying figure represent the case in elevation. The dotted diagonal line *E D*, joining points in the surfaces of the two reservoirs immediately over the ends of the pipes, is the hydraulic grade line. If the main were furnished with a series of vertical pipes, rising from it, the water in each of these pipes would stand at that level where said line cut such pipe. At the junction *J* this level would be at *K*, or 158.33 ft. above datum. Now if the level of *F* is 100 ft. above datum, as shown in "A B C's" diagram, and as stated in his first paragraph, the pressure at *F*, with *F* closed and *A*, *B*, and *C* open, would be that due to a static head of 158.33 — 100 = 58.33 ft., which would give a pressure of 58.33 × .434 = say 25.31 lbs. per sq. in., instead of 50 × .434 = 21.7 lbs. per sq. in., as it would be from *D* alone, with *B* and *F* closed, and *A* and *C* open. But if the height of *F* above datum is *o*, as stated by "A B C" further on (and as it would have to be to give it a static pressure of 65 lbs. per sq. in. from *D*, as he says), then the pressure at *F*, with *F* closed and *A*, *B*, and *C* open, would be that due to a head of 158.33 ft., or 158.33 × .434 = 68.71 lbs. per sq. in., instead of 150 × .434 = 65.1 lbs. per sq. in. from *D* alone. But in either case the *additional* pressure at *F* (closed) caused by opening *B*, would be that due to the height *J K* (8.33 ft.) of the hydraulic grade line at *K*, above the level of *D*. This *additional* pressure would be = 8.33 × .434 = 3.61 lbs. per sq. in.



A Hydraulic Conundrum.

The position of the hydraulic grade line would be changed somewhat by contractions or irregularities in the pipe, or by sudden bends in its course, but is otherwise independent of the course of the pipe, as seen in elevation, provided the pipe is everywhere below it,

X. Y. Z.

ENGINEERING NEWS

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D. McN. STAUFFER. A. M. WELLINGTON.

EDITORS.

GEO. H. FROST, - - - BUSINESS MANAGER.

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Coming Technical Meetings.

Civil Engineers' Society, St. Paul, Minn. — Regular meeting, Aug. 6. Secy., G. L. Wilson, City Hall.

New England Roadmasters' Association. — The 6th annual meeting will be held at Boston, Mass., August 15, 16. Secy.; W. F. Ellis, Roadmaster, Providence & Worcester R. R. Woonsocket, R. I.

American Association for the Advancement of Science. The thirty-seventh meeting will be held at Cleveland, O., from August 15 to August 21, 1888. The headquarters will be at the Hollenden. For particulars address F. W. PUTNAM, Salem, Mass.

Engineers' Society of Western Pennsylvania, Pittsburg, Pa.—Regular meeting, Aug. 21. Secy., S. M. Wickersham, Penn Building.

Engineers' Club of Kansas City, Mo.—Regular meeting, Sept. 3. Secy., Kenneth Allen, 19 Deardorff Building.

American Society of Civil Engineers, New York.—Regular meeting, Sept. 5. Secy., John Bogart, 127 E. 23d St.

Roadmasters' Association of America.—Next meeting at Washington, D. C., Sept. 11. Secy., H. W. Reid, Waycross, Ga.

Boston Society of Civil Engineers, Boston, Mass.—Regular meeting, Sept. 19. "House Drainage". Secy., S. E. Tinkham, City Hall.

Engineers' Club, Philadelphia, Pa.—Regular meeting Oct. 6. Secy., Howard Murphy, 1128 Girard St.

American Society of Mechanical Engineers.—Convention and annual meeting at Scranton, Pa.; beginning Oct. 15 Secy., F. R. Hutton, 280 Broadway, New York.

IT will be remembered that in an editorial in our issue of June 23, on the railway construction of the present year, we took occasion to point out the error into which a sanguine contemporary in Chicago had fallen through its desire to gain notoriety by predicting a great mileage of railroad construction for the present year. The same journal in its last issue under the appropriate head "Unreliable and Misleading Statistics" takes us to task for our doubtless unwelcome correction, accuses us of divers errors, the ground for which is its own infallibility, and closes by declaring that 'it will be well for the public to be on their guard against accepting figures compiled by other publications.'

We do not propose to take up our space and our readers attention by any long controversy over this matter. As our contemporary publishes the records of work on the different lines only in a fragmentary manner in its weekly issues, and never publishes detailed lists of the work on which it is supposed to base its statistics, it is doubtless able to make its figures at the end of the year lean toward the fulfillment of its former prophecies to a good degree. But rather than enter into a lengthy exposé of its errors, we will close the matter by calling attention to the alacrity with which the prophecy which it put forth was modified to meet our recent criticism. In its issue of June 8, it said:

"The total [of track laying] for 1888 is well nigh certain to exceed our previous minimum estimate of 8,000 miles, with a likelihood that it will reach 10,000 miles and a possibility that it may not fall short even of 12,000 miles."

In ENGINEERING NEWS of June 25, we called attention to this sanguine prophecy and the reasons why its fulfillment was out of the question. Evidently our argument was appreciated by our contemporary. In its issue of July 6, though it claimed an addition of 1,049 miles during the month of June, which, if true, should have certainly strengthened it in its confident stand, it deemed it safest to begin to look after its reputation as a seer, and temporized as follows: (The italics are ours.)

"While the amount of track actually laid in the last six months is very large, and under ordinary conditions would indicate that *something like* 10,000 miles would be laid during the year, *there has been a change of conditions* which just now *does not make it probable* that this proportion will be carried out."

The fact that the general probabilities of the year's business were on the whole much brighter at the time of the above "hedge" than they were at the time of the original lofty prediction of "ten or twelve thousand miles", leads us to wonder whether the mysterious "change of conditions" above referred to would ever have occurred if the bearing of certain plain facts upon the actual probabilities of railway construction had not been brought to the attention of our contemporary by their publication in this journal.

THE Nicaragua Canal Co., through its engineering staff, has shown able management and shrewd business prudence and common sense in securing the most ample technical data for its proposed work on the Isthmus. As a foundation for further work, the company is said to have in its possession a more complete topographical map, with 10 ft. contours, of the part of Nicaragua affected, than now exists of the State of New York, excluding in the latter, Coast Survey maps. Taking into consideration the short time consumed in these surveys, Messrs. MENOCAL and PEARY and the engineers under them have done wonders in the way of gathering information, and have now reduced the problem to a study of the best route the region will afford, based upon reliable data covering a broad area of available territory.

THERE is a marked difference in the way this company has inaugurated a great public work and that which attended the early stages of its ill-fated predecessor, the Panama Canal. The Frenchmen called a Congress in Paris and upon surveys which amounted to none at all, upon the dictum of travellers ancient and modern, and without reliable information upon the work proposed, proceeded to raise millions of money and to expend much of this money in experimental work and in preparing for a colossal undertaking the ultimate dimensions of which were literally unknown. The lack of thorough preliminary surveys was the rock upon which the Panama enterprise has well nigh wrecked itself; for had the enormous cost of carrying out of the original sea-level plan been fully realized at the start, the French investing public would either have withheld their subscriptions and thus have saved their money; or, some alternate and cheaper plan would have been adopted and a water-way of practical value and reasonable cost now be open from sea to sea. There is a homely wisdom in Davy Crockett's advice—"Be sure you are right, then go ahead"—that applies most directly and in a telling manner to such great public works as propose the cutting of a continent and the blending of two oceans. If *all* the necessary data is first gathered, the final cost can be very closely forecast, and the many difficulties incident to such work, reasonably discounted. If the scheme is launched upon this basis of sound figures and the public accept these figures and show their confidence by their acceptance of the company's paper, the scheme is "all right" and the work can be commenced with energy and certainty of speedy success. But to accept subscriptions upon false or obscure data, without a limit fixed other than in promises based upon no foundation, is a fraud upon the confiding investor and a check upon the progress of equally useful and better handled improvements throughout the civilized world. The Nicaragua company has made a good beginning and deserves credit for using every means available to first ascertain the true dimensions and ultimate cost of the proposed work before commencing construction and inviting public confidence. It is an honorable and sensible policy and the world will be justified in looking forward with certainty to the full and speedy completion of the American canal enterprise.

AN item is going the rounds of the papers describing an invention of a Columbus, Ohio, genius, for lighting railway cars with electricity by means of a primary battery, the cost of which, the inventor claims, well be less than by kerosene. The battery uses "zinc and carbon plates with a new kind of solution." It is strange how many men with no knowledge of correct scientific principles think to solve the hardest problems in physics and mechanics. Granted, for argument's sake, that the inventor has so perfected this primary battery that it is free from the practical mechanical defects to which all others are subject; He than consumes zinc in a chemical solution instead of coal or petroleum in the atmosphere, and the cost of his units of energy thus derived must be far in excess of what they would cost if produced by the combustion of fuel. It is a simple enough problem to produce a good electric light from a primary battery; but everyone familiar with the principles of modern science knows that it is necessarily too expensive to ever be practical.

IT is strange how long it takes to educate the public, and even the most intelligent part of it, to a proper comprehension of the fact that energy, in all its forms of heat, light, power and chemical or electrical activity, is as susceptible of measurement as are the ordinary commodities sold by weight and measure. A proper comprehension of this by the public at large would save the waste of millions of dollars. Everyone knows nowadays that something cannot be made out of nothing, and the old fallacies of the philosopher's stone and the mysteries of alchemy are no longer believed in; the truth that matter is indestructible and uncreatable has been perceived. It yet remains to be taught, however, that energy in all its forms is just as indestructible and uncreatable and that it is not possible by any hook or crook or device to create any form of energy or increase it in any artificial way over the amount which we take from Nature,. Every teacher of engineering, especially, should be sure that a thorough appreciation of this fact is impressed upon his pupils; and the time must soon come when this simple but vitally important principle, on which all our modern mechanical development is based, will be carefully taught by the public schools.

OUR readers who have watched the progress of the Reading Terminal project in Philadelphia, as noted in these columns from time to time, will remember that public opinion at the outset was largely hostile. As the scope and purpose of the company's plans became better understood, however, the tide of sentiment has turned more and more in its favor; and when the city's legal representatives coolly knifed the proposition three weeks ago, a protest was uttered by press and people that must have made the offending councilmen tremble in their shoes. The press, which in April was inclined to descant on the merits of underground railways and the evils of monopoly, is now a unit in favor of the work. Relying on this public sentiment, President CORBIN now declares his intention of going ahead at once with the construction of the elevated railway between Green and Market Streets, believing that Councils will not dare do otherwise than give permission to erect the necessary street bridges when they meet in the fall. The company has purchased its right of way, on which it can proceed to erect its structures at once without especial permission from the municipal government.

This prompt action of the Reading company is ten times more to the benefit of Philadelphia, than it is to the benefit of the company itself. The Reading company takes it, relying on the citizens of Philadelphia to see that justice is done; and it should not be obliged to purchase justice at aldermen's prices either. If the voters and business men of Philadelphia relapse into lethargy on this subject, and permit their obstructive city government to interpose any further obstacle to the carrying out in full of the plans for the Reading terminals, it will be a stain on the City's honor not easily wiped out.

THE searching examination which is in progress at Des Moines, Ia., to determine the manner in which the Iowa Railroad Commission has gone to work to make out a schedule of freight rates for the railroads of that State, and the degree to which they have realized the important and momentous nature of the work entrusted to them, is bringing to light some very curious things. In the preliminary examination which the Commission conducted, of farmers, merchants, railway managers and others, the notes of the examination were taken by a stenographer; but only fragments were ever copied for the use of the board. The only record of the proceedings of the board seems to have been a very informal diary kept by the Secretary. This official also testified that he had altered the official schedule as it had come from the State printer in several particulars, sometimes at the suggestion of one member of the board and sometimes at the request of another. Commissioner SMITH testified that in his opinion a railroad tariff might be just and reasonable when it did not pay the operating expenses of the road that used it. When asked who was to pay the company's deficit, he replied, "It's not my business to worry over that."

The Nebraska Commission put into legal operation on July 20, a schedule of freight rates, by which all charges are based on the first-class rates now in force, which the companies are forbidden to raise. That being considered as the unit, the rates on other classes are to be a certain percentage of this, varying between 20 and 85. The railway companies will refuse to abide by the new tariff and will contest its legality in the courts.

IT is a delicate and responsible work which the State undertakes when it assumes the right to fix the prices at which a man or corporate person shall sell the products of his industry, after great amounts of wealth have been expended in the establishment of that industry, under the supposition that its prices were to be fixed by the ordinary laws of trade. Granted that the necessity requires the interference of the State in the matter of railway rates, it must be plain that the only position it, or its representatives, can justly occupy, is that of an equitable judge, to determine fairly and impartially at what point the rate shall be fixed to give to the railway owner a fair profit on his investment, if that be possible, and to the shipper and traveler such reasonable rates for freight and passage as shall not unjustly tax them for the benefit of the railway owner. A schedule of rates made out haphazard by men unfamiliar with railway business, and altered or amended at the temporary whim of a single man, comes very far from this description and will fail to receive commendation at the bar of public opinion as well as in the courts.

THE Kutter fund has again to be credited with its usual and very gratifying weekly rate of increase, and we now feel that our original estimate of the engineering interest in Mr. KUTTER and his works was not far astray, modest though this estimate was when compared with the value of his services. A few more such generous contributions as our present list records, and the widow will have occasion to hold in proud and ever grateful remembrance the substantial appreciation, by American engineers at least, of her husband's professional labors. The list now stands as follows:

Previously acknowledged	$738
Employés Clinch Valley Extension N. & W. R. R.	
J. B. Walker	$1
Ed. F. Gray	1
Ormond Butler	1
N. C. Vawter	1
F. W. Carpenter	1
J. A. Clark	1
G. T. Barnsley	1
Wm. M. Hall	1
Total	8
P. J. F.	2
Arthur S. C. Würtelle	10
A. A. Robinson	10
Gilbert Murdock	5
"Cleveland"	10
O. Chanute	1
E. W. Grant	1
S. E. Babcock	10
Thos. C. Keefer	50
Total	$845

From the efforts now being made to bring this fund to the attention of irrigation companies and those substantially interested in the economical use of water power, we feel certain that the ultimate dimensions of this fund are not yet reached. We know it only needs a moment's thought to warrant the forwarding of a generous contribution from this source.

Rock Fill Reservoir Dams.

In describing the Nicaragua Canal project in our issue of July 15, we spoke adversely of the proposition to build elaborate concrete or puddle wall dams for the numerous dams and embankments required in that project, and which constitute so favorable a feature of it, both directly as saving much canal excavation and indirectly as substituting free navigation in slack-water basins for contracted canal channels. Chiefly as bearing on that project, but also for the more general purpose of discussing a neglected type of construction, we propose to discuss the features of another type of dam, singularly well adapted to the Nicaraguan conditions, but also well adapted to many other localities, somewhat in detail.

Some years ago—it is now a good many years—it became necessary to renew or replace the famous Cascade Bridge on the New York, Lake Erie & Western Railroad. Most engineers have heard of that bridge, and know that it was in its time (1837) a great engineering triumph; a wooden arch of very considerable span and rise, constructed over a deep rock gorge on the descent to the Susquehanna from the main divide between the Susquehanna and Delaware River valleys, at a time when it was not the simple matter it is now to pass such gorges by iron trestles or long span bridges.

The bridge would doubtless be standing now and rendering good service except for the tendency of wood to decay, but by 1850 it was felt that the bridge should not be trusted much longer, and in view of the difficulty which still existed in spanning such gorges it was deemed preferable to fill the gorge at once and carry a solid road bed over it.

Then arose the question as to how the stream in the bottom of the gorge was to be carried through the fill. The original engineering staff, who showed such excellent judgment and skill, were then all gone, and in their absence a bright idea occurred to the Superintendent, who was grappling with the question as engineer *ex-officio*. History will not record his name, at least in these columns. We could easily ascertain it, but we do not now remember it, and as the bright idea did not prove a particulary successful one, it would be superfluous to hunt up a name to bear the burden of a failure.

The bright idea was this: A masonry culvert would be inevitably expensive. The fill was over 100 ft. deep in the center; the fall of the gorge was rapid, which would add considerably more to the length of the culvert; and the slopes of the gorge were so precipitous that the culvert could not well be shortened by putting it in level, starting from the bed at the upstream end, even had that idea occurred to the Superintendent, which is hardly likely, as it does not occur even to many engineers when it would really give quite as serviceable a structure as one in the very bottom of the fill.

The place, moreover, was an awkward one for the masons to get at and work in; the culvert must be an arch of considerable span; suitable stone must be brought from a distance. On the other hand, there was abundance of rock above, such as it was, some of which must be excavated anyway. Why not make all the bottom of the fill of large rocks, through the cavities of which any amount of water could find its way, through large enough channels to carry leaves and sand through likewise, especially if the water backed up somewhat and gave a little head? No caving in of this natural culvert need be feared. It would cost almost nothing extra, since most of the rock must be dumped in there anyway; and the work, moreover, could be carried on tentatively, continuing the rock fill until it was clear that there was abundant space to let the water through, and then only beginning to fill with earth.

We cannot assert positively that these were the exact arguments which passed through the Superintendent's mind in favor of his bright idea; they may have been more or fewer than those we have chronicled; but they must have been in substance as those above, since there is no doubt of the main fact, that his conclusion was precisely what these arguments point to, that a natural, multiplex culvert through the voids in a rock fill, was the proper thing for this locality; nor is there any doubt that he immediately proceeded to put the idea into practice. No doubt he also concluded that it was the proper thing for a good many other localities where engineers wasted money in masonry, and was thankful that he was not troubled with any such official.

The fill was begun, and it "functioned" precisely as expected, until the fill had been car-

ried up to a considerable height. The water passed through freely. The fill could not be completed in one season, but the bottom of it was high and dry above the water all the time, and finally mixed rock and earth, as it happened, began to be dumped in. But here ends the era of success. It was noticed by the observing, even before this began, that the freedom with which the water passed through seemed to be gradually diminishing, and long before the embankment was up to grade, the passage of water became so slow that it backed up seriously after every rain, and it was apparent that ere long it was likely to cease altogether, and the culvert embankment became what it has since become, and is now, as respects the bottom, a *a rock fill reservoir dam*, practically impervious to water, even without any aid from art to make it so. The question then came up what to do; and what was done was to drive a tunnel in hot haste behind and around the rock fill, through the solid rock, to let the water off; and this culvert tunnel has continued ever since to discharge all the water of the gorge, the rock fill being practically tight.

The reason why it should become so is not far to seek after the event, at least: In any such irregular mass there must be cavities and corners where the water is almost still, and other places where the passages are very narrow. The velocity or head of the water in passing through these devious passages is almost lost. Every leaf and twig and grain of sand and blade of grass that is carried down by the stream is pretty sure to lodge somewhere in the mass, and however slowly the process may go on the end is sure; the dam will grow tighter and tighter from such leakage as there may be, and not weaker and weaker, because the passing water does its worst possible work first, while the dam is building, sweeping out all loose matter there is to sweep out, and never again having so good a chance to do destructive work as it does when the interstitial passages are all unobstructed. Even then, its destructive work is destructive only of sources of weakness or failure, creating voids, where voids are possible, which the mass above falls into and closes, unless it is too solidly placed to permit further enlargement of the hole under any circumstances thereafter.

Thus was practically taught a valuable engineering truth which has found singularly little lodgment in the books and practice of engineers. In each, the recognized forms of dams may be said to be only three; (1) timber and cribwork, (2) earth banks, with or without puddle, (3) masonry. Timber dams are good and useful, and last a long time, but they rot at last, and hence are unsuited to localities where permanency is an essential feature. Earth and puddle dams are good and useful when only still water is to be dealt with, not running over the crest, and counting in all reservoir walls as dams, which they are, such dams are vastly more used than any other; but they have to be made with the greatest care, an inner wall of puddle is necessary to their integrity if of any height; they must be carried down to firm and impervious sub-soil of some kind or they are worthless, and any considerable leak is at once fatal to them. They are also subject to serious injury from musk-rats, crabs, and many other animals. Nevertheless, many earth dams of great age and great height exist, and bid fair to exist for ages yet, showing that it is entirely possible to make them secure. A paper by R. E. PEARY, Civil Engineer, U. S. N., before the American Association for the Advancement of Science (1887) gives a striking and convenient list of these, as follows:

"Of earthern dams and embankments there are numerous and stupendous examples. The Montaubry dam, on the *Canal du Centre*, is 54 ft. high; the water supply of Dublin is impounded by a dam 66 ft. high; the reservoir dam of the Bolton water-works, England, is over 120 ft. high; the Oued Muerad dam, in Algeria, is 95 ft. high. In India and Ceylon the examples are very numerous; the embankment of the Ashti reservoir is 58 ft. high and 12,709 ft. long; the Karakvasla dam is over 70 ft. high; the Tansa reservoir dam (water supply of Bombay) is to be 8,500 ft. long and 118 ft. high; the embankment of the Cummum tank in the Madras Presidency is 102 ft. high, and although it ranks among the earliest works of Hindoo history, it is still in such condition as to fulfill its original intention; and in Ceylon are old tanks with embankments from 3 to 12 miles long and 50 ft. to 70 ft. high."

Masonry dams of all sizes, ages, and dimensions exist in great abundance, and its entire suitability for the construction of dams is too well established for discussion. Lists of all the higher dams of the world were given in our issue of Jan. 7, 1888, in discussing the proposed great Quaker Bridge dam, 286 ft. high, which can unquestionably be constructed with safety. None of the great dams have spill-ways over the crest, which are difficult to securely provide for in masonry dams, as they are impossible in earth, but when that is not necessary and there are no pipes or culvert passages to be made through the mass (a great source of weakness in all dams) both masonry and earth dams can as a rule be made entirely secure.

These three types afford an adequate choice for nearly all requirements, but it is obvious that they are open to certain common objections from which the fourth type of a rock fill dam is free. They are all comparatively costly; they require a good deal of labor, and much of it skilled and faithful labor for its construction; they can only with great inconvenience be constructed with water around them, which for the most part must be kept away by costly coffer-dams or diversions of channel; above all, a leak is always a source of danger, and is apt to be destructive. They are all of them, as it were, during all their existence, in unstable equilibrium; all right so long as the balance of forces remains undisturbed, but seriously endangered by a variety of causes which may disturb it. On the other hand a rock fill dam is by the very process of its construction, if conducted with reasonable judgment, a structure which tends to improve with time, and which cannot be injured but may be benefited by causes which threaten the other and more artificial types; in other words it is a structure which may not be very tight, but which is in stable equilibrium as respects all disturbing causes, being improved and never injured by them.

Precisely such a dam as this was proposed for the great Gamboa storage reservoir, at the time when the problem of controlling the Chagres had not been given up as hopeless; and it was much the most sensible element of the original Panama project, enormously costly because of its bulk, but unquestionably feasible and adequate; a structure which once built would stay built. We discussed this project more in detail in our issues of Feb. 11 and June 2.

We have an impression that by a little search we could find records of a number of dams so constructed, but they do not occur to us now, and certainly there are but few of them, so few that even the type does not enter into the calculations of engineers as a rule, as is curiously illustrated by the elaborate reports on the Quaker Bridge dam, reprinted in our issues of Jan. 4. and Feb. 11, 1888, in which various other alternates for the masonry type are suggested, an earth dam with masonry core, an iron dam, an inclined masonry wall supported on arches, etc., are suggested, but no reference is made to what would certainly be a better alternative than any of the other substitutes suggested, a rock fill dam. We must not be understood as suggesting that it would be expedient to substitute such a dam for masonry at the Quaker Bridge, for we do not believe it. The Quaker Bridge dam seems to be peculiarly one demanding and warranting the use of masonry. Nevertheless, a strong argument might be made for the construction of such a dam even here, as may readily be seen by referring to the sections published in our issue of Feb. 4. The whole height of that dam is 258 ft., the lower 88 ft. of which is an excavation carried down through very solid and compact earthy material in order to make a water-tight connection with the rock. Imagine this substratum simply trenched and filled with a wall of monolithic concrete, merely to check the formation of large subterranean water channels. Imagine further two rock fills started above and below this wall but little below the natural surface, at such distance from each other (some 530 ft. out to out of slopes) as to meet on top in a single fill some 20 ft. wide with 1½ to 1 slopes, care being taken to fill all the voids as they progressed with sand and earth compact under water, so that the interior space would be water-tight the concrete wall being carried nearly or quite to the top. Imagine further this fill backed on the inside by any desired thickness of earth and puddle. We merely outline the details, but it will be obvious that such a dam would at least be absolutely safe against everything but leakage under all contingencies. It probably would never be as tight as a well built masonry dam, especially at first, but it would grow tighter with age, and its tightness could be indefinitely increased by the simple expedient of puddling the inside face. The pressure of water could have no measurable effect on such a mass, any more than upon a similar mass of earth, but the constant danger of possible failure from large leaks, which justly excludes an earth dam from consideration, would not exist with such a compacted mass of rock, while the elaborate and costly foundation work which is indispensable to ensure the safety of a masonry dam, with its narrow base, is all saved. The thickness at the bottom increases so rapidly with the height as to make the question of insuring sufficient tightness very much simpler.

Now if it be remembered that each yard of rock excavation makes 1¼ yards of such a fill, and that there is abundance of suitable rock for such a purpose close at hand, and if the probable cost of masonry and of such a rock fill per cubic yard be figured out, it will be found that there is sufficient contrast to enable a tolerably thick layer of one-dollar bills to be used for puddling the back slope, (at $6.50 per sq. ft. of bills) and still leave the rock fill dam the cheapest.

But we have spoken of this work, not as a good example, but distinctly as a bad example, of the proper use of such construction in place of masonry or other types of dam. It is obvious that the place of all places for the proper use of such a rock fill dam is where leakage is of no importance, either from the loss of water or from injury to land below, where skilled labor is scarce and costly, and simplicity of work rather than aggregate quantities the important consideration; where good materials for masonry are scarce or absent, and where the surroundings do not demand attention to the question of appearance. None of these conditions, but directly the contrary, obtain at Quaker Bridge, making it the place of all places where a masonry dam would seem the proper thing. All of them obtained at Gamboa, and all of them obtain likewise at the proposed Ochoa dam of the San Juan river on the Nicaragua route, and at eight or ten other points on that route. We had in-

tended devoting the close of this article to the consideration of those localities, but our space requires us to postpone all attempt to do so to a following issue.

Water, by Meter, or by Assessment.

The article on "Water Charges, by Measure and Assessment," elsewhere given, contains much merit; and the subject is just now one of the greatest interest to both purveyors and consumers of water throughout the country. The problem is how to receive an equitable return for service rendered and yet to do justice to all concerned. As the writer of the article remarks, the mathematics of a water supply is easy enough and the value of water readily obtained when the following premises are fixed:—1. The amount of supply. 2. The cost of delivery. 3. A percentage to cover depreciation of plant. 4. A reasonable interest on the investment.

But it is just in these items that no two water corporations can or do exactly agree; and the difference in surrounding conditions, methods and management make it impossible to formulate any rule approaching universal application. The English statement of the case in the article referred to is chiefly interesting to American readers for the plan upon which the problem is worked out; but we have reason to believe that figures based upon a greater per capita consumption and more perfect appliances for measuring the water would give very different results in a tabulation of American practice.

We can fully agree with the writer's assertion that no perfect water meter has yet been made to answer *all* of the requirements stated; and we might go still further by adding, nor ever will be. Several makers of water meters in this country furnish machines that long experience proves capable of fulfilling the "needful conditions" of (1) positive action; (3) compact; (4) inexpensive; (5) easily read; (6) easily repaired; (7) not requiring constant attention and (8) noiseless. But the 2nd condition, "not liable to damage by frost", is one which the oldest makers say can never be realized. In support of the above statements as to the merits of American machines it may be said that meters have been in active service here for 8 or 10 years without being removed for any cause. And as to durability under service we have at hand the records of one ¾ in. meter (CROWN) that on the basis of 5,000 cu. ft. per year (average work for a meter of this size) has actually done work enough in 52 months to be equivalent to an average service of 248 years, and it was then removed, not for any defect, but for exhibition purposes by the maker.

The statement made in the article that there are "many other difficulties" in the way of largely augmenting meter service on a domestic supply, including in these increased capital to purchase and set them, and the staff to keep them in order, is best met by reference to the annual reports of American cities extensively using meters. The city of Providence, R. I., for example, requires only three men to read, superintend and keep in repair over 7,000 water meters; and deducting frozen meters, the cost of repairs upon 3,331 Crown meters, valued at $62,097, was 65-100 of 1 per cent. for the whole period of use, though some of these meters had been set 7 years.

The "increase in capital" referred to must be offset by the decrease in pumping expenses or the checking of waste; and as to "constant disputes", the meter is the settler of all disputes, for by measurement through a reliable machine the consumer only pays for what he uses and *wastes*.

We believe with the writer that there is no question as to the advisability of measuring all water supply for trade purposes, but would go further in stating that under the many existing conditions in our own country, at least, there is much to be gained in metering also the domestic supply of large cities. The consumer must in any event pay the cost of the water supplied him, whether the supply comes from works supported by a municipal tax, or from a private corporation; there is no charity basis of charge in either case. And if water meters check waste by noting individual consumption, abolishing defective plumbing and detecting leaks on the premises, as we believe they do, the domestic consumer gains, along with all other taxpayers, in the reduction of expenses chargeable to his account, or in an increase of public revenue if waste continues.

We are well aware that there is a popular prejudice against the metering of the domestic supply in our large cities and towns, but this prejudice seems to be founded on ignorance of the ultimate purpose and effect of such service and the merits of modern meters. The outcry against the accuracy of water measuring machines is a repetition of the old opposition to gas meters, a machine even still quoted as the most false of all inanimate objects; and yet who would for a moment suggest the sale of gas by an assessment such as now generally regulates the amount paid by the water consumer? Water is a cheap commodity, so cheap that a slight inaccuracy in register can be disregarded if it did exist; but water nevertheless costs money to supply, and from the volume demanded by American consumers it costs a great deal of money which the public must pay for somehow. And it is the office of a good meter to fairly apportion this tax among the consumers; to compel the man who derives the most benefit from public water to pay the most towards the cost of supply; to save money to the whole public by discouraging waste and to prevent the careful consumer from being compelled to pay for the waste of his neighbor. Its general adoption would in a great measure abolish the complicated system of guessing which now founds water rates upon the frontage, the stories or the number of families in a house and makes one rate for a barber shop and another for a slaughter house, etc. Any one at all conversant with the management of a water department knows to his sorrow the almost countless complaints which pour into such an office from those consumers who either misinterpret or purposely attempt to evade the law; and the further fact, that unless the premises are under a constant—and practically impossible—inspection, injustice is being done either to the consumer or the supplying party, a fact made very apparent by the sudden and radical jump in assessments which follows every periodical revision and adjustment of rates.

How much easier would it be, and more satisfactory to all concerned, if all this confusion and source of dispute were reduced to the simple reading of a meter-dial. With the quantity actually consumed a known amount, it is an easy matter to adjust the price among the consumers so that he who uses millions of gallons can have a rate accordingly, and the householder be taxed only an equitable sum for the benefits he derives. All rates should be as low as possible; and under a systematic supply of this kind we do not fear that any consumer would stint himself to save a few pennies in a month. The water-user would very probably pay more attention to his fixtures, if he felt that he had to pay for leaks on his premises, and would find other methods of stopping pipe-freezing than by allowing untold gallons of a useful commodity to run to waste in the city sewers. But while he might at first resent the presence of a telltale meter in his cellar, every sensible man would soon realize that a check on wholesale waste was money in his pocket; and if he did not realize this, he ought to be made to pay for his individual carelessness. That Americans are beginning to think better of meters is evident in the fact that whereas in 1886 there were only 53,907 of these machines in 59 towns and cities, the number now actually in use exceeds 150,000 as near as we can gather from the statistics available.

PERSONAL.

PRESTON C. COUBILLON has been appointed Parish Surveyor for Avoyelles, La.

WM. A. CAUL, Telegraph Superintendent of the Cincinnati, Wabash & Michigan Ry., died at Wabash, Ind., July 16.

A. GAZLAY has been appointed Contracting Agent of the Cincinnati, Hamilton & Dayton, with headquarters at Cincinnati, O.

E. A. GARVEY, recently Chief Engineer of the Texas & Pacific, is interested in the enterprise of building a railway from Winchester to Cumberland Gap, Ky.

PIERRE AUBERT, Chief of Works at Lock No. 5 on the Panama Canal, in Emperador Section, died lately, according to the Panama *Star and Herald*.

M. BONNEVAL, a well-known Engineer, and Director of the works at La Boca, on the Panama Canal, died about the first of this month, from cause unstated.

E. M. LEUFFER, Civil Engineer, died on July 23 at Hoosick Falls, N. Y. He was formerly connected with the Boston, Hoosac Tunnel & Western R. R., and was well known in Pennsylvania.

Col. HENRY L. ABBOTT, U. S. Eng'rs., was on July 25 appointed President of the Board of Engineers and Fortifications, to succeed Gen. CASEY, promoted to Chief of Engineers.

ANTOINE VANNEAU, who succeeded M. JACQUIER, on his departure for Europe, as Director General of the Panama Canal Co., died on June 27. The *Estrella de Panama* charges his death to "a malignant fever;" more probably yellow fever, from which his predecessor has just recovered.

G. M. SERPELL has resigned the Presidency of the Chowan & Southern R. R., and GEORGE S. SCOTT, President of the Richmond & Danville, was elected to fill his place. Mr. SERPELL was elected Chief Engineer and Manager of the road.

THE firm of ROSEWATER & CHRISTIE, of Omaha, Neb., has been dissolved. ANDREW ROSEWATER, the senior member, will continue the business; and G. B. CHRISTIE, the retiring member has gone into the contracting business with JESSE LOWE.

THOMAS O'BRIEN, Master Car Builder of the Pittsburg, Cincinnati & St. Louis R. R., has resigned to accept a similar position on the New York, Pennsylvania & Ohio, with offices at Galion, O. He will be succeeded by JAS. SWANN.

GEN. WM. CARTER WICKHAM, late Receiver of the Chesapeake & Ohio R. R., died in Richmond, Va., on July 23. Mr. WICKHAM was born in 1821 of an excellent Virginia family; opposed secession, but on the departure of his State from the Government fold he entered the Confederate army, and was a Brigadier General of cavalry. He was long connected with the Chesapeake & Ohio R. R. in various capacities.

A. H. SMITH, formerly Assistant Mechanical Superintendent, has been appointed to take charge of the mechanical departments of the Southwestern and Northern divisions of the Grand Trunk with headquarters at Toronto. PETER CLARKE, formerly Mechanical Superintendent of the Northern Railway, will have charge of the mechanical department of the Grand Trunk from Toronto to Kingston, with office at Toronto.

THE bequest of CHAUNCEY HURLBUT of $225,000 to the Water Commissioners of Detroit, made in Sept., 1885, and since contested by some of his heirs, has been declared valid by the Court. The heirs will appeal to the Supreme Court. Mr. HURLBUT left no children, and having devoted his time for some years to improving the city's water facilities, he left $50,000 at his death, directly to the Water Commissioners "to improve, beautify and adorn the water-works grounds", and also provided that on the death of his wife the $175,000 left her for life should be devoted to the same use. The widow died in 1886.

JAMES T. CLARK, General Superintendent of the Chicago, Milwaukee & St. Paul R. R., died at Milwaukee, Wis., July 21. Mr. CLARK was born April 7, 1832, at Cadiz, O. He entered the railway service April 1, 1853, and worked till May 1, 1873, on the Chicago, Burlington & Quincy as follows: To Oct. 1, 1853, as a teamster on grading; from Oct. 1, 1853, to March 15, 1859, as a section foreman; from March 15, 1859 to May 1, 1873, as Roadmaster; from May, 1873 to June, 1877, as Division Superintendent of the Union Pacific; from June, 1877, to May, 1882, as General Superintendent of the same road; from May, 1882, to date, as the General Superintendent of the Chicago, Milwaukee & St. Paul.

Lieut. Col. WALTER MCFARLAND, U. S. Engineers, late in charge of the Government works at New York, died at his residence in New London, Conn., on July 22. Col. MCFARLAND was a native of New Jersey, and was graduated from the West Point Academy in 1860, ranking first in his class. His first professional service was as Assistant Engineer in the construction of the defences of the approach to New Orleans and from there he went to Key West. He served from 1861 to 1866 as an Engineer, being brevetted Captain for gallant and meritorious service, and again Major for his work at Charleston. He was Chief Engineer of the 16th Army Corps, having charge of the defences of Mobile, and was Assistant Adjutant General of the 13th Army Corps from June to August, 1865. In March, 1867, he was promoted to Major, and in March, 1884, to Lieut. Colonel, U. S. Engineers. Since the war he has had charge of the harbor and river improvements on Lake Erie; at Fort Wayne, Mich.; the Tennessee and Cumberland rivers, etc. He was also engaged as an expert in connection with the proposed Nicaragua canal.

An Engineer's Notes on the Methods and Progress of the Work at Panama.

I visited the line of the Panama Canal, and observed the situation of affairs there, during the early part of this month (July, 1888). I had availed myself of a similar opportunity in 1885. I give herewith the results of my observations, as noted in my memorandum book at the time.

CULEBRA.

At Culebra there are some twenty Belgian excavators on the ground, but during an entire day spent in and near the great cut I did not see more than three at work at the same time, and not one of these was doing effective work.

There is a great deal of noise and bustle here at times, screaming of locomotive whistles, and sounds of escaping steam from the excavators, well calculated to deceive anyone passing in the cars, or a casual visitor to the work, but there are no chips flying. The up-cut excavators would make a complete revolution without carrying over a shovelful of earth in the entire fifteen buckets, then bite into the bank and stop with the strain, ease off, start again, carry over one full bucket and two or three half filled ones, and then make another empty revolution: and this not as an exception but as the rule. The down cut excavators, almost without exception, had trouble with the iron apron which keeps the buckets from emptying prematurely, the lips of the buckets catching under this apron and spilling their load alongside the track.

All these excavators have a large gang of men (over 50 in some instances) to attend them, some ahead of the outer end of the bucket-ladder, breaking down and loosening the earth so that the buckets can pick it up, others throwing the spilled material back in front of the buckets, and others moving track.

The tracks through this cut are lined with cast-off buckets and parts of machinery.

There has been some work done at Culebra since I saw it in 1885, but in comparison with the total to be done, the new cuts are like the furrows in a ploughed field. Looking down from the height of Culebra into the peaceful valley of the Rio Grande far below, with only a narrow drainage ditch in the center, and a few isolated patches of fresh earth here and there — everything else having already been reclaimed by the ever-encroaching tropical vegetation —the colossal grandeur of the assertions that the canal will be opened in 1890 becomes oppressive.

ROCK CUTTING OF OBISPO.

Here there has been considerable work done since 1885, a, ü there is a decided show of activity. The drilling is done with churn drills, the material thrown out by the blasts being further broken with sledges and wedges, and then lifted in large iron buckets by 4-ton travelling cranes and dumped in cars. But there is here, as at Culebra, the impression of non-effectiveness. The cranes are made to wait for the spoils trains, the trains for the cranes, and both for the shifting of the tracks. There seems to be no concert of action, each machine and each man working independently of all others.

MACHINERY AND METHODS.

Near Kilometer 53 (east end of Culebra) a timber platform and tower for engines, pumps and bucket-elevator, is being erected over a shallow puddle formed by the drainage from the cut above. Scattered about this puddle are two dredges improvised by mounting two Belgian excavators on scows and lengthening the bucket chains, and three or four iron scows for transporting the dredged material.

I was informed by a foreman that it was the intention to launch (!!) these dredges soon and set them at work. The material dredged is to be deposited in the scows, transported under the tower, lifted and then washed through 20-inch tubes into the Rio Obispo, some distance to the eastward. During the dry season the water to keep these dredges afloat and sluice the material away is to be pumped from the Obispo.

At the south end of the proposed summit-level, at the site of Lock No. 6, a similar tower is being erected, the material to be discharged into the neighboring valley of the Rio Grande, and at Lock No. 9 a third.

At Lock No. 7 the excavation is being done by Decauville cars and stationary engines which haul the cars to the top of the bank, whence they are pushed to the dump by hand.

At the south end of the excavation, which is in no place over 12 ft. deep, rock has already been encountered.

At Lock No. 8 the excavation is already its entire extent in the hardest of trap rock, and the drilling is being done entirely by hand,—a drill and a sledge to each man. The stone from this excavation is being broken for concrete, mostly by hand, though there are some crushers at work.

Just south of this lock there is a ledge of solid rock across the line of the canal, upon which little or no impression has been made, and upon which no work seems to be doing now. A beginning of work has been made at Locks Nos. 8 and 10.

GENERAL IMPRESSIONS.

The unavoidable impressions gained from the four days spent in watching the work are of non-effectiveness, and that, in spite of the immense amount of costly machinery and plant which has been sent to the Isthmus, the work is being done by hand labor.

There is not a power drill as far as I could learn, in operation on the Isthmus.

At Obispo, there is a gang of men carrying rock from the cut upon their backs, in kerosene oil tins.

As far as my observation goes, and I was over every section where any work is in progress, there is not an excavator on the Isthmus that is doing excavation work; they are simply elevators transferring material previously excavated by hand, to the cars, and doing this in a very wasteful manner.

There is no responsibility or accountability for material or work.

As a result of the method of letting work in each section to many different contractors, without (apparently) any restrictions as to dumping-ground, instead of letting an entire section to full depth and width to one party on carefully digested studies of where every yard of earth should be deposited, fully ninety per cent. of all material excavated is handled twice and three times.

Most of the excavating and dumping plant is badly deteriorated, and should the work continue a year longer, nearly if not quite all of it will have to be replaced.

The intention in regard to the locks is evident; they are to be the trump card, the public is to be kept informed of progress upon them; they will be represented as all that remains to be done to enable the canal to be opened; and when they are completed it will be heralded with a grand flourish of trumpets, and a call will be made upon the "faithful" for money for "maintenance" perhaps—the fact that millions of cubic metres yet remain to be excavated before even a tadpole could navigate from lock to lock being serenely ignored. The locks will take the place of the "finished section" as the company's *piece de resistance*.

THE FEELING ON THE ISTHMUS.

Both at Panama and along the line of the canal one can get as much and as contradictory information as he has capacity to absorb, but two or three things will show the pulse on the Isthmus.

In one street in the central portion of Panama I saw more than three-fourths of the houses to rent. The proprietors of the canteens or restaurants from San Pablo to Panama were unanimous in saying that their business now is anywhere from one-quarter to one-third of what it was one year ago, and the station agents say their receipts are about in the same proportion.

There is a great deal of sickness on the Isthmus. One foreman at Culebra told me that at his hotel a man died the previous forenoon, another in the afternoon, a third early that morning, and two more would probably die during the day.

M. JACQUIER, the company's Director-General, had fever early in the summer, and left for France when convalescent. M. ANTOINE VANNEAU, his successor, died on June 27. M. BONNEVAL, the Director of the works at La Boca, near Panama, died in the early part of July.

Among all classes, and especially among the foremen and laborers on the canal line, there is a lack of faith and confidence, and there is no such abundance of money on the Isthmus as there used to be. The flush times are over. ENGINEER.

Metric Weights and Measures.

THE committee appointed by the Boston Society of Civil Engineers, on Nov. 16, 1887, to consider the above subject make a report, just published, to the following effect:—Certain questions were put to vote among the members of the Society, but while the 42 per cent. answering these questions evidently favored the introduction of the metric system into the United States, the opinion of the committee was that the Society as a body did not feel inclined to unite with the Western Association of Architects in petitioning Congress to adopt the metric system in the Departments of the U. S. Government, this proposed union being the purpose of the committee action.

In a supplementary report, Mr. CHARLES H. SWAN, Chairman of the Committee, calls renewed attention to the fact that by the recent act of Congress, approved May 24, 1888, the President of the United States is authorized to invite the several governments of Mexico, Central and South America, Brazil, etc., to join the United States in a conference to be held in Washington sometime in 1889. The purpose of this conference is to discuss the formation of an American Customs Union, and the adoption of a uniform system of weights and measures. As each government is to have a single vote and the metric system is already in use in the custom houses of these countries, and is legalized in the U. S. Customs, there is little doubt of the action of the conference in this particular direction.

In sifting the extracts from replies attached to the committee's report, it would seem that with many otherwise favorable to decimal division the metre is objected to as an exceedingly ill chosen unit of length. The replies would indicate that there is little trouble in working to metric dimensions in the office or shop, but that there is hardly enough saving in labor to warrant a universal change Among these replies the most elaborate is one showing an estimated saving of nearly 50 per cent. in time in teaching arithmetic, in schools. Another correspondent of 8 or 10 years experience in the use of metric scales claims that he saves much time in his office calculations by reducing all measurements to the metric system. He considers the metre as an arbitrary standard, but says that its length does not bother him, as it is a question of decimal or binary divisions rather than standard value.

One Man's Influence on the Manchester Ship Canal.

It is sometimes curious to note the extent to which a single individual can influence the plans of large public works in England. A bill has just come before a select committee of the British House of Commons, having for its object the abandonment of a portion of the works of the Manchester Ship Canal and the substituting therefore of other works.

In his address, Mr. PEMBER, Q. C., the Counsel for the Bill, stated that the cost of the works proposed to be abandoned was £1,041,574, and the works proposed to be substituted were estimated to cost £1,028,000 so the Company would save £13,000, or $65,000 by the alteration.

It appears that a landowner in the neighborhood —HUMPHREY DE TRAFFORD, had been a vigorous opponent of the whole scheme of the Ship Canal, and on account of his opposition the canal had been kept as far as possible from his land, so as to destroy the value of his opposition. Since that time however, the man had died and been succeeded by his son, who was favorable to the scheme, and he could see in it his own advantage, and the Canal Co. were therefore anxious to abandon the route they had been forced to take by the opposition of the old man, and move their canal to the more favorable line, which the young man had now rendered possible. The Engineer of the Canal gave evidence that the amended route would increase the water space above the dock entrances from 100½ to 114¼ acres, the quay space from 83 to 152 acres, and the quay frontage from 4 miles to 5¼ miles.

It would also obviate the necessity entailed by the authorized scheme of ships passing through Nos. 1 and 2 docks to get into No. 3. It seems strange that a magnificent scheme, like the Manchester Ship Canal, should have been so crippled at its most important point, by the opposition of one old man, whose property would be enormously increased in value by the construction of the very works he so opposed. It was shown by a petitioner against the alterations —the township of Stratford—that the alteration would reduce the rating of their township about ten dollars per annum. Therefore this township puts in an opposition, though generally the construction of the canal would immensely increase the value of all property in its jurisdiction. The case illustrates very fairly the unwieldy character of British legislation in respect to undertakings of a purely local character and for which no Imperial interference is really needful.

A New System of Generating Steam.

A new system of generating steam has been invented by Mr. R. SCOTT, 237 Stanton Street, Newcastle-on-Tyne, which is based upon the dynamic principle that heat is a mode of motion, and that the nearer the centers of energy or combining parts of the atoms are to the furnace plates, the greater is the amount of heat transmitted to the water. Frequently in the body of the burning fuel there is upwards of 8,000 degs. of heat, while in proximity to the furnace plates less than 3,000 degs. of heat. If the heat does not reach the furnace plates, it cannot be transmitted to the water. The nearer, therefore, the centers of energy are to the furnace plates, the greater will be the efficiency of the boiler. To secure the full benefits of this law, Mr. SCOTT has entirely dispensed with fire-bars, and the fuel is placed upon the bottom of the furnace, and combustion is supported and stimulated to any extent desired by the introduction of concentrated currents of air under pressure. The concentrated currents of air pass through suitably constructed tuyeres, which are surrounded by water.

While greater economy is secured by burning the fuel upon the furnace plates, yet the centres of energy are then too far removed from the furnace plates. To overcome this defect and further increase the efficiency of the system, a large tube is placed in the furnace, the size of this tube varying according to the size of the furnace. In a furnace 36-in. diameter this tube would be 22-in. diameter, and placed 2-in. from the top of the furnace, leaving 12-in. from the bottom of the tube to the bottom of the furnace for burning the fuel. Mr. SCOTT claims that this internal tube greatly adds to the efficiency of the system. The flame and heated gases are forced between this tube and the furnace: The flow of the heated gas is retarded, and the practical effect is much increased by reason of the heat being concentrated, and made to impinge upon the plates. This internal tube has two connections with the top of the furnace, and two connections with the bottom of the furnace. It promotes a large and constant circulation of water in the boiler, thus retarding the formation of incrustation, and causing the water to be of an equal temperature, while it also produces an equal expansion upon the furnace plates. In converting water into steam, a film is formed upon the plates, and, as this film is a non-conductor, it retards the ready transmission of the heat to the water. The great circulation of the water through this tube and through the boiler diminishes the film, brings the water into closer contact with the plates, and further increases the efficiency of the system.

In Cornish and Lancashire boilers this tube extends the whole length of the flue; while in marine boilers, it extends from the front of the furnace to the rear of the combustion chamber. In the most essential part of the furnace the heating surface is three times greater than where fire-bars are used, and the effectiveness of the heat is more potent. The feed-water enters the bottom of the large tube, and passes through the furnace before it is delivered into the general body of water in the boiler. In this system the gases pass twice through the boiler after leaving the furnace, and the remaining energy they possess is utilized in heating the feed-water. It has been scientifically demonstrated that there is a cold zone upon the surface of metals that have water behind them, consequently no injury is done to the plates by this method of burning the fuel. As a matter of fact the plates do not accumulate the heat, but act as a medium in transmitting it to the water. Stoking and firing is greatly facilitated, and the furnace can be thoroughly cleaned out in four minutes. The smoke nuisance is also reduced to a minimum.

Mr. SCOTT has made arrangements for building boilers upon this principle, and also converting those in use, and upon all boilers built upon this principle Mr. Scott will give a guarantee that in Lancashire and Cornish boilers the system will save 40 per cent. in quantity of coal, and in marine boilers 35 per cent., over the most improved methods where fire-bars are used; but as the most inferior kinds of coal can be thoroughly utilized, the saving in money value is much greater, and the inventer claims that it varies from 40 to 70 per cent., according to the kinds of coal used.

Iron and Coal Trade Review.

CRAVEN'S traction increaser, which is an automatic device for transferring a part of the weight of the tender to the driving wheels of the locomotive, is said to have given very satisfactory results in a trial recently made on the New York, Lake Erie & Western Railway. It was first attached to a consolidation engine, which made time between Hornellsville and Susquehanna with 10 per cent. more than its customary load. Upon another locomotive with 18 x 22-in. cylinders, total weight 38 tons and weight on drivers 48,000 lbs., a dead weight of 2,000 lbs. had been placed on the foot board to increase the adhesion. This weight was removed and the traction increaser attached, when the engine pulled in one case 12½ per cent. and in another case 14 per cent. more than the regular load, making good time in both cases, though a fine mist made the track extremely unfavorable.

A COMPOSITOR on the New York *World* set up 2,000 ems from the dictation of Edison's new phonograph. Two small tubes were fitted to his ears and connected by a large tube with a phonograph. The latter was run by a small electric motor and regulated by a pedal attachment by which it could be started and stopped at the compositor's pleasure. The phonograph would talk off a sentence into the printer's ears and then be stopped until he had put the words in type. This is obviously one of the many ways in which the machine may make itself hereafter a highly important factor of modern civilization.

ACCORDING to the *Railway Press*, there are 6,211 passenger stations in the United Kingdom, which is one station for every 19.1 square miles of area, and one for every 3.1 miles of line. The average number of passengers per annum for each station is 130,750.

IT is stated that within the past two years 37 new steamers have been contracted for along the Great Lakes at a cost of $7,000000, and that there is over $40,000,000 of American capital employed in the carrying trade of these vast inland seas.

CONSTRUCTION NEWS.

RAILROADS.

East of Chicago.

Existing Roads.

Brookfield.—

BROOKFIELD, N. Y., July 25, 1888.

EDITOR ENGINEERING NEWS:

This railway is to run from North Brookfield station on the Delaware, Lackawanna & Western Railroad to Brookfield, New York, a distance of 7 miles. Contract for building the line was let June 22 to Isaac J. Griffith, of Utica, N. Y., to be completed Oct. 1, 1888. Work and grades are fair. There is one trestle 240 ft. long and 56 ft. high. The road will carry both freight and passenger traffic. WM. STANBRO of Brookfield is President of the company, H. L. SPOONER is General Manager, and WALTER F. RANDALL of Oneida is Chief Engineer.

M. L. BROWN, Secretary.

Canadian Pacific.—There seems every reason to believe that the company intends to build the extension, located over a year ago, from London to Windsor, Ont., a distance of 112 miles, at an early date. Agents of the company have recently purchased a considerable length of river frontage at Windsor. Right of way proceedings are also in progress between Hamilton and Woodstock and in and near London.

Concord.—The Lake Shore R. R. from Alton to Laconia, N. H., for whose construction a charter was granted by the last Legislature, has been located and the right of way secured. The grading is to be completed by Nov. 1, and it is hoped the weather will permit putting the line in operation before the close of the year. The line will be 18 miles in length.

Hartford & Connecticut Western.—At the meeting of the directors of this company on July 24, JOHN W. BROCK of Philadelphia and JULIUS H. APPLETON of Springfield were elected directors. Steps were taken to expedite the construction of the branch from Tariffville, Ct., to Springfield, Mass.

Quebec Central.—This company is marketing an issue of $1,000,000 five per cent. bonds in England. The principal part of the money will be used in the completion of the Chaudière Valley branch from St. Francis, P. Q., southeast into the State of Maine, a distance of 46 miles.

Long Island.—The company will issue $3,000,000 of 4 per cent. bonds for the improvement of terminal facilities, the purchase of new rolling stock, and the building of the extension to Oyster Bay.

Elmira, Cortland & Northern.—A survey is reported in progress from Elmira to Williamsport, Pa. and it is said that the company intends to build the line, which will parallel the Pennsylvania Northern Central road, to give a northern outlet to the Philadelphia & Reading.

Pemberton & Hightstown.—This New Jersey road whose operation was recently abandoned by the Pennsylvania, has been leased by a local company, chartered as the Union Transportation & Construction Company, who will operate the line. FRANK S. GASKILL of Pemberton is President.

Baltimore & Ohio.—"Vice-President Lord, of the Baltimore & Ohio, thinks the Philadelphia extension of his company is a fine piece of road, of which they can feel proud. The new station in Philadelphia is not equaled by many in the country, of which fact, Mr. Lord says, he is a little bit ashamed, because Baltimore and Washington still continue to have the old stations. But he says the two latter cities will soon have new stations. The work of double-tracking the last 20 miles of the Philadelphia division is going on, and will be completed in the fall."—Baltimore *Sun.*

Central R. R. of New Jersey.—The Lehigh Valley interest in this company, amounting, it is said, to 26,000 shares, has been sold to President CORBIN and other parties interested in the Reading company. The Lehigh and Jersey Central companies, however, will go on with the construction of their joint terminals at Jersey City, and no change in the relation of the companies is probable.

Lehigh Valley.—The company has begun running through Pullman trains between Philadelphia and Chicago, connecting at Buffalo with the Grand Trunk, and intends soon to extend the same service to New York City.

McKeesport & Bellevernon.—Tracklaying began on this road at Pittsburg, Pa., on July 20, at the connection with the Pittsburg, McKeesport & Youghiogheney.

Cleveland & Canton.—The gauge of this road will be changed to standard, it is stated, within 90 days.——On the extension from Coshocton to Zanesville, O., about 18 miles of track are laid and work is in progress.

Cincinnati, Hamilton & Dayton.—The 9 mile extension to Findlay, O., is completed, and the first train was run over it on July 23.

New Projects and Surveys.

Brantford, Waterloo & Lake Erie.—

BRANTFORD, Ont., July 24, 1888.

EDITOR ENGINEERING NEWS:

The Brantford, Waterloo & Lake Erie Ry., is to run from Waterford on the Canada Southern to Brantford, a distance of 18 miles and thence to Toronto, 77 miles from Waterford. It will give the Michigan Central a through line to Toronto. The line has been all surveyed this year, right of way is secured, and capital has been raised, half in bonuses and the the rest on bonds. Contracts are to be let in about one month. G. H. WILKES is President of the company.

J. J. HAWKINS, *Secretary.*

Manchester & Portland.—

MANCHESTER, Ct., July 24, 1888.

EDITOR ENGINEERING NEWS:—

This is a railroad which is projected between Manchester and Portland, Conn., or rather from Rockville *via* Manchester to Portland, Conn. The road has not yet got to the point of having a name. The line will probably follow the Hockanum River valley *via* Glastonbury to Portland, making its total length about 30 miles. The enterprise is projected in the interest of the manufacturers along the route. N. T. PULSIFER.

Pres. Manchester Business Men's Association.

Vincennes, Oakland City & Owensboro.—This company is disappointed over the defeat of the subsidy on which a vote was taken at Booneville, Ind.

St. Lawrence & Adirondack.—A meeting was held at Valleyfield, P. Q., recently, to consider the advisability of granting a bonus of $10,000 to this company, which proposes to build a railroad from Valleyfield, P. Q., to Malone, N. Y.

Chicago, Dayton & Cincinnati.—An election is to be held in Wabash and Hartford townships, Indiana, on August 20, to vote on the question of aiding this company to the amount of $16,000. The line is to run from Huntington, Ind., to Versailles, O.

Oxford Mountain.—A meeting of this company was held recently at Waterloo, P.Q., and the following officers were elected: G. G. STEVENS, President; W. W. LYNCH, Vice-President; GARDNER STEVENS, Secretary and Treasurer. The country to be opened up by the road is a rich section of the Eastern Townships.

SOUTHERN

Existing Roads.

Northwest & Florida.—This company has been incorporated in Alabama as successor to the Montgomery & Florida, whose purchase by the bondholders at foreclosure sale was announced last week. N. T. SPRAGUE, of Brandon, Vt., was elected President.

East Tennessee, Virginia & Georgia.—Much interest has been excited over the report that the controlling interest in the preferred stock, held by the Richmond & West Point Terminal Co., has been purchased by the Norfolk & Western. The facts of the deal have not been authentically published; but it is deemed to be certain that it is being negotiated. Should the Norfolk & Western be able to consummate this deal, it will take rank among the important systems of the country, as it will control a total mileage of over 2,150 miles. The controlling interest in the preferred stock of the E. T. V. & G. ($6,500,000 out of a total of $11,000,000) was purchased by the Richmond & West Point Terminal Co., in January, 1887.

Orlando & Winter Park.—Tracklaying is completed on this Florida road and the line will be ballasted and open for traffic by Aug. 1. J. H. ABBOTT, of Orlando, is Chief Engineer.

Atlanta & Florida.—Tracklaying was completed on this line to Fort Valley, Ga., on Thursday, July 26. The total distance from Atlanta to Fort Valley is 100 miles, of which 30 miles were laid in 1887. Engineers are to be put in the field at once to locate the road to Waycross, 140 miles; but it is not yet decided whether the road will go in this direction or to Thomasville.

Georgia Southern & Florida.—The tracklayers on this road from Macon to Valdosta, Ga., have reached a point about 60 miles south of Macon.

Covington & Macon.—On the northern extension of this Georgia road, the tracklayers have reached Fanningtou, 13 miles from Athens.

Tennessee Midland.—At a recent meeting of the Virginia Construction Co., which is building this road, it was voted to put the 50 miles of line between Jackson and the Tennessee river under construction at once. President JAS. C. PACE resigned, and R. H. TEMPLE, Chief Engineer, was elected to succeed him.—President BUFORD of the Virginia Western Co., which is to build the Virginia division of this line, has requested the Board of Supervisors of Rockbridge county, Va., to transfer the $105,000 bonds of the county, being the balance of the unpaid subscription to the Valley Railroad, to a trustee. The bonds to be delivered to the railway company on completion of the line from Lexington to Buchanan. The Valley Railroad authorities will grant the right of way over their partially constructed line.

Carolina, Cumberland Gap & Chicago.—A corps of ngineers is soon to be put in the field under JAS. G. GIBBES, of Columbia, S. C., to make the surveys between Pickens and Asheville for which the Charleston Chamber of Commerce is now raising funds.

Richmond & Danville.—A force of convicts is grading in Red Marble Gap on the Murphy branch of the Western North Carolina Railroad.

Nashville, Chattanooga & St Louis.—The citizens of Charlotte, Tenn., are anxious to have the line extended to that point from its present terminus, a distance of about 12 miles.

Central Railroad of Georgia.—The contract for the extension of the Buena Vista & Ellaville to Columbus, Ga., has been let to the Chattahoochee Brick Co., of Atlanta. The extension, which is about 30 miles in length, is to be completed by Jan. 1.

St. Cloud Sugar Belt. — Grading is reported in progress on this Florida road, which is to be 10 miles in length, extending from Kissimmee to Runymede, where are extensive sugar cane plantations.

Louisville & Nashville.—E. B. DORSEY, M. Am. Soc. C. E., was engaged as an expert by English holders of this company's stock who were dissatisfied with the declaration of the last semi-annual dividend in stock instead of cash, to examine this company's affairs.

Mr. DORSEY's report, dated July 23, warmly commends the policy of the company in expending its earnings for extensions and betterments and paying its dividend in stock. He reviews the various sources of traffic for the road, referring especially to the iron industry of the region about Birmingham, Ala., of which he says:

"A large area of the central portion of the district penetrated by this road and its branches contains extensive coal measures, iron mines, and limestone quarries in close proximity. For the manufacture of iron, for which there are facilities far exceeding those of any other part of the United States, good labor is abundant and cheap, and it may be said without fear of successful contradiction, that in no part of the world can iron be produced more cheaply than at Birmingham, Ala., and its vicinity."

"The Hon. Abram S. Hewitt, one of the most extensive, successful and experienced iron makers of the United States, speaking in Congress of the Birmingham district, said it was the only place upon the North American continent where it is possible to make iron in competition with the cheap iron of England, as measured, not by wages paid, but by the number of days' labor which enter into its production. The cheapest place on the globe until now for the manufacture of iron was the Cleveland district, in Yorkshire, England; the distance of coal and iron from the furnaces there averages about twenty miles. In Alabama, coal and ore are in many places within four miles of each other. I think this will be a region of coke-made iron on a scale grander than has ever been witnessed on the habitable globe."

"Any reduction that can or will be made in the import duties upon iron in the United States cannot affect this iron-producing center to any serious extent, as the facilities at hand are such that they can produce iron as cheaply as it can be produced in any part of the world."

After a careful examination, he reports himself satisfied that the road will be a large dividend payer in the near future.

New Projects and Surveys.

Waynesborough, Pascagoula & Gulf Coast.—A meeting of the incorporators of this company was held at Scranton, Miss., on July 20. Dr. J. R. S. PITTS was elected President, M. M. EVANS, Vice President, and P.K. MEYERS, Secretary.

The road is projected to extend from Waynesboro, on the Mobile & Ohio Railroad, to the Gulf Coast, probably at Moss Point at the mouth of the Pascagoula river, a distance of about 90 miles.

Mount Pleasant & Seaview City.—This line was chartered 14 years ago to build a railroad from Mount Pleasant, S.C. to Sullivan's Island, a ferry connection with Charleston being had at Mt. Pleasant. Various attempts have been made to build the line but financial difficulties or local jealousies have always interfered. It is now announced, however, that a strong company has taken hold of the enterprise and will complete the line by May 29, 1889. Maj. R. C. GILCHRIST, of Charleston, is President of the company.

Atlanta, Atlantic & Great Western.—The surveys under Chief Engineer WM. H. PRYOR have been completed from Atlanta to Eatonton, Ga., and the corps is to go on at once with the division from Eatonton to Savannah.

Orange, Hammond & St. Johns.—This is a newly incorporated Florida company which is to build a railway from Altoona to the St. Johns river, a distance of about 25 miles.

Cairo & Tennessee River.—A subscription has been raised at Mayfield, Ky., to pay for surveys on this line from Mayfield to Cairo, about 40 miles. B. A. NEAL, of Mayfield, is President.

Mobile, Jackson & Kansas City.—The two companies incorporated under the name of Mobile, Hattiesburgh & Jackson in Alabama and Mississippi have united under the above title. H. AUSTILL, of Mobile, is General Manager.

Memphis, Tuscaloosa & Atlantic.—It is reported that work will be begun on this road, which is to run from Tuscaloosa, Ala., to Memphis, Miss., by the middle of September. The city of Tuscaloosa is to give the company $80,000 and terminal facilities. W. C. JEMISON, of Tuscaloosa, is interested.

THE NORTHWEST.

Existing Roads.

St. Paul, Minneapolis & Manitoba.—About 35 miles of track has been laid on the Willmar & Sioux Falls extension, leaving 112 miles still to lay.—On the Watertown & Huron extension, in Dakota, about 53 miles are laid, and the 17 miles remaining will be finished by Aug. 10.

Winona & Southwestern.—It is authoritatively announced that the contract for the first 20 miles of this road from Winona southwest, has been let to Foley Bros., of St. Paul. Grant & Co., of Faribault are said to have a sub-contract for bridging, and the Joliet Steel Co. will furnish the rails. The site has been selected for the terminals at Winona.

Manitoba.—Premier THOS. GREENWAY and Attorney General MARTIN, of Manitoba have come to New York, it is supposed to make final arrangements with the Northern Pacific financial officers regarding the building and operation of the proposed system in Manitoba. The Hudson Bay project is held in abeyance until the Northern Pacific matter is settled.

New Projects and Surveys.

Eau Claire, Mississippi River & Lake Superior.—Grading is to begin at once on the division between Eau Claire and Independence, of this Wisconsin road; and it is intended to complete that portion of the line this year. The general offices of the company are at Eau Claire.

Maquoketa, Hurstville & Dubuque.—This company has been organized at Maquoketa, Iowa, to build a railroad from Maquoketa north toward Dubuque, about 30 miles. C. M. SANBORN is President, JAS. BURNS is Vice-President and A. HURST is General Manager.

Quincy, Omaha & Kansas City.—The city council of Quincy, Ill., has granted this company land for enlarged terminal facilities at that city, and the company will erect at once a new passenger and freight depot and new stock yards.

THE SOUTHWEST.

Existing Roads.

Houston, Central Arkansas & Northern.—Grading is reported in progress on 10 miles of this road in northern Louisiana, under the company's direction, no contracts being let. W. A. BRIGHT, of Little Rock, Ark., is Supt. of Construction.

Atchison, Topeka & Santa Fé.—Scott Bros., of Rich Hill, Mo., have just finished a 25 mile grading contract for this company.—The extension to San Angelo, Tex., of the Gulf, Colorado & Santa Fé system will be completed about Sept. 1.—It is reported that a survey has been made for an extension in the extreme southwestern part of Kansas from Ashland *via* Meade Center, West Plains, Springfield, Moscow, Woodsdale, Moonlight and Richfield.

Paragould & Buffalo Island.—This Arkansas line is to be pushed west to the St. Francis river. JNO. B. BOYKIN of Paragould is Chief Engineer.

St. Louis, Arkansas & Texas.—The people of Jefferson, Tex., are working hard to raise the subsidy asked to secure the extension of this road *via* Honey Grove, Mt. Pleasant and Jefferson to Shreveport, La.

Texas Trunk.—General Manager MOWRY is in Boston conferring with the owners of this property. It is probable that money will be raised to put the line in thorough repairs.

New Projects and Surveys.

Kansas City, El Paso & Mexican.—The party making the preliminary survey of this line from El Paso, Tex., northeast, have reached White Oaks, N. M.

Kansas City, Lawrence & Nebraska.—At a recent meeting of the directors of this Kansas company at Lawrence, HOWARD M. HOLDEN was elected President, J. M. WEBSTER, Vice-President, and JOHN JEWETT, Treasurer.

St. Louis, Hannibal & Omaha.—A railroad meeting was held at Kirksville, Mo., on July 20, to raise funds for the preliminary survey of this proposed line. S. M. PICKLER, of Keytesville, is President of the company.

New Projects and Surveys.

Leavenworth & Denver Short Line.—The Leavenworth (Kan.) *Times* has the following good one:

"Mr. MCCARTY, the surveyor who is establishing the route of the Denver Short Line, in the preliminary survey of the road, reports that the surveying party met with some trouble at the farm of Mr. WINTERS, in Salt Creek valley. The party had reached a point adjacent to Mr. WINTERS' farm and were preparing to go through. They had set up the poles and other apparatus used in the surveying when Mr. WINTERS' son-in-law, who is operating the farm, came out to them, threw down the flagpole and warned the party to keep off the premises, saying that he wanted no surveying done on his farm, and threatening to otherwise resist all efforts to go through the premises. He started back to the house, presumably after a gun, but Mr. MCCARTY, desiring no trouble with him, brought the party back to the city."

We commend most heartily Mr. MCCARTY'S conservative prudence and caution. It will be remembered that the contract for making the survey for this great transcontinental air line was let to Mr. MCCARTY some time ago. As he is working "by the job" it is quite unlikely that the company would grant a pension to his widow *in case* the churlish settler really intended to get a gun, and *in case*, when he had got the gun, MCCARTY had persisted in his attempt to survey this transcontinental air line straight through the man's farm, and *in case* the settler had fatally shot MCCARTY in revenge for the driving of pegs on his land. In the second place, it was really a pity to excite the man's passion, and perhaps cause bloodshed, by going across the man's farm, when it was exactly as easy to go around it. And there can be no manner of doubt that the delay to trains on the Leavenworth & Denver Air Line on account of the detour around PERKINS' farm will never amount to one second.

ROCKY MOUNTAIN & PACIFIC.

Existing Roads.

Mexican National.—General Freight and Passenger Agent WALTER MORCOM is reported to have a novel scheme in view for the comfort of passengers on his line when it is completed and through trains are running from Laredo, Tex., to the city of Mexico. Dining cars will of course be run on the trains and no stops for meals will be necessary. On the long run from Laredo to Monterey, the first stop made of any interest to the

passengers will be in the morning after the night's ride, out from Laredo. This stop will be at the famous Tope Chico Hot Springs, four miles this side of Monterey. Every passenger will be supplied with a bath ticket before the train pulls in to the springs, and, instead of the brakman yelling "twenty minutes for breakfast" as the train stops, he will shout: "Hot Springs; one hour for baths."——It is announced that $600,000 will be spent in the erection of repair shops at Laredo.——It is now expected to open the whole line for through traffic on Sept. 16.

Mexican Interoceanic.—The prospectus of this company whose progress in organization has been noted from time to time, has now appeared. The company is an English corporation, and according to its prospectus has been formed for the purpose of purchasing the existing railways and branches, about 255 miles in length, of which 240 miles are in operation, known as the "Interoceanic railway from Acapulco to Vera Cruz." Also to construct an additional 239 miles so as to form a through line of railway of about 474 miles from Vera Cruz to the City of Mexico, and thence to Amacusac, with 20 miles of branches. The sections of the main line still to be constructed are: Vera Cruz *via* Jalapa to Varela, 148 miles; Pueblo to near Mazappa, 45 miles; Yantepec to Amacusac, 46 miles. The branches to be built are from Vireyes to San Juan de Los Lanos, 7 miles; from San Lorenzo to San Nicholas, 10 miles; San Lazaro to the Custom House 3 miles. The engineers of the company, Messrs. Jas. Livesey & Son, 2 Victoria Mansions, London, have made a careful investigation of the country, routes, produce, population, traffic, etc., and report favorably on the prospects of profit for the enterprise. The works contract has been let to Messrs. Delfin Sanchez & Co. Under it the contractors are to repair the existing lines and build the new sections referred to, the operation of the railway being carried on by them till the whole is completed and ready for transfer to the railway company. Besides the lines named, the company has an option to extend its main line from Amacusac to the Pacific ocean at Acapulco, about 210 miles, which option becomes void if not exercised by May 5, 1890. Messrs. Ashurst, Morris, Crisp & Co., 6 Old Jewry, London, E. C., are the company's solicitors.

Atchison, Topeka & Santa Fé.—The various rumors of extensions projected by this company into the country northeast of Denver have prompted an explicit denial by the officers, who state that even the extension which has been surveyed from Denver to Golden, is not likely to be built for many months to come.

Northern Pacific.—A press report from Spokane Falls, W. T., says:

"The Seattle, Lake Shore & Eastern and the Northern Pacific are still disputing over the right of way through the Grand Coulee. Both roads have large forces of men at work, and the courts are to be appealed to to settle the dispute. It is rumored that the Northern Pacific is sending rails by team from Sprague to the Coulee in order to secure its claims by completing its track-laying."

A report from the Coeur d'Alene region states that 1,500 hands are at work grading on the lines of this company, and the Oregon Ry. & Nav. Co., each trying to secure the important passes ahead of the other. It is believed that the Northern Pacific will build into the Coeur d'Alene from the east and make this the main line, saving thus the present long detour to the north.

Southern Pacific.—The citizens of Seattle, W. T., are excited over the rumor that this company intends to build north to a terminus at West Seattle at an early date.

Berkeley Park.—About two miles of grading have been completed on this suburban motor line at Denver, Col. It is expected to complete the road and open it for business by Oct. 15.

Atlantic & Pacific.—A new iron bridge is to be built across the Colorado river near the Needles, Cal. It will cross the river at Red Rock some distance below the present structure and will require the laying of about 13 miles of new track.

New Projects and Surveys.

Bellingham Bay Ry. & Navigation Co.—This enterprise, which was fully reported in our issue of April 28, has secured nearly $300,000 in local aid and its managers expect to begin construction at an early date. The line is to run from Seattle, W. T., to the International boundary, about 120 miles. EUGENE CANFIELD, of Seattle, is President of the company. The surveys for the line have been largely completed.

Kirkland Land & Improvement Co.—Incorporated in Washington Territory by GEO HEILBRON, W. W. WILLIAMS and LEIGH S J. HUNT, with a capital stock of $1,500,000. Its purpose is stated to be "to build and operate water-works, railroads, tramways, wharves, gas works, bulkheads and all kinds of things necessary to the welfare of the people and to the profit of the incorporators."

Stockton & Lodi.—Incorporated in Stockton, Cal., by H. J. CORCORAN, J. D. MCDOUGALD, H. M. FANNING, GEO. A. ATHERTON and R. R. SMITH to build a railway to Lodi. Capital stock, $250,000.

Elk Mountain.—Engineer WIGGLESWORTH is making the survey of this Colorado road. The line will be about 35 miles long, reaching the coal mines of Rock Creek. O. METCALF, of Denver, is President, and H. H. FISHER Room 27, Taber block, Denver, is Secretary.

Proposals Open.

Sewers.—Brick sewers, 1,140 ft. and 2,063 ft. of 36-in. S. C. SLAYMAKER, City Engineer, Lancaster, Pa. July 30.

Street Work.—Regulating, grading, curbing and flagging. THE COMMISSIONER OF PUBLIC WORKS, 31 Chambers St., New York City. July 31.

Iron Bridge.—Across the middle branch of the Croton river at South East reservoir, Putnam Co. THE COMMISSIONER OF PUBLIC WORKS, 31 Chambers St., New York City. July 31.

Water-Works.—Trenching, back filling, and pipe laying. The engineer's estimate of the work and material is as follows: about 4,100 ft. of 4-in. pipe, 2,000 ft. of 6-in., 3,000 ft. of 8-in., 500 ft. of 10-in.; 63 hydrants, 40 valves, 100 specials; 100 cu. yds. rock. Work to be completed by January. Engineer, HERBERT R. BARTOW, Centreville, R. I. V. A. BAILEY, Secretary, Pawtuxet Valley Water Co., Phenix, R. I. July 31.

Retaining Wall.—Stone retaining wall on Lachine canal, below Cote St. Paul lock, on the south side of the canal. E. H. PARENT, Superintending Engineer, Lachine Canal, Montreal, Canada. Aug. 1.

Engine House.—GEO. R. GRAY, Superintendent, Newark Aqueduct Board, 130 Halsey St., Newark, N. J. Aug. 1.

Water-Works.—Complete system. One duplex pumping engine of 1,000,000 galls. daily capacity, one boiler 50 ins. by 14 ft., one stand-pipe 16 by 80 ft.; 2,400 ft. of 10-in. cast-iron pipe, 2,600 ft. of 8-in., 14,500 ft. of 6-in., 4,500 ft. of 4-in.; 20,000 lbs. specials; 20 stop valves and boxes, 60 double nozzle hydrants. W. S. PARKER, Engineer. THE BOARD OF WATER COMMISSIONERS, Vassar, Mich. Aug. 1.

Sewers and Street Work.—ERNEST ADAM, City Surveyor, Newark, N. J. Aug. 3.

Sewer.—W. C. SPAULDING, Auditor of the Board of Education, Cleveland, O. Aug. 6.

Street Work.—Grading and cobblestone paving. JOHN P. ADAMS, Commissioner of City Works, Municipal Building, Brooklyn, N. Y. Aug. 6.

Bridge.—Over Willapa river. E. B. WOOD, Oysterville, Wash. Ty. Aug. 6.

Bridge.—Low truss iron bridge. ISAAC DUNN, County Auditor, Cannelton, Ind. Aug. 6.

Bridge.—High truss covered wooden bridge across Greenbrier river. R. H. GITTILAN, Falling Spring, Va. Aug. 7.

Sewers.—Terra cotta pipe sewers, concrete sewers and receiving basins. CHAS. W. RAYMOND, Engineer Commissioner, Washington, D. C. Aug. 7.

Dredging.—About 5,600 cu. yds., at Coaster's Harbor Island, Newport, R. I. JAMES FULTON, Paymaster General, U. S. N., Navy Department, Washington, D. C. Aug. 7.

Fire Hose.—Cotton, rubber lined hose, with standard couplings; 4,000 ft. of 2½-in. THE FIRE COMMISSIONERS, 157, 159 E. 67th St., New York City. Aug. 7.

Pipe, Specials and Valves.—Cast-iron water pipe special castings, valves. CHAS. W. RAYMOND, Engineer Commissioner, Washington, D. C. Aug. 8.

Bridges.—Bids and plans for two bridges. E. E. MONTAGUE, Albany, Linn Co., Ore. Aug. 8.

Sewers.—Pipe drains; 6-in. and 12-in. vitrified pipe, Y branches and lamp holes. THOS. J. LANAHAN, Clerk, Board of Contract & Apportionment, Albany, N. Y. Aug. 8.

Excavation and Foundation.—Earth excavation; foundation for hospital at Spencer. H. S. WALKER, Secretary, Board of Public Works, Charleston, W. Va. Aug. 13.

Water-Works.—Complete system. One duplex high pressure pumping engine of 1,000,000 galls. daily capacity; one duplex compound condensing pumping engine of 500,000 galls. daily capacity, 2 boilers and stack, engine house, one artesian well; 15,000 ft. of 10, 8 and 4-in. cast-iron or kalamein pipe, with specials, valves and hydrants. Engineers, LOWETH & CURTIS, St. Paul, Minn. HENRY B. KELLEY, Chairman, Water-Works Committee, Vinton, Ia. Aug. 15.

Water-Works.—Complete system; daily capacity 150,000 galls. Source of supply about 7¾ miles distant; reservoirs shown on a detailed drawing in the office of J. T. DONNELLY, City Auditor. S. B. MCCORD, Mayor, Baker City, Ore. Aug. 15.

Bridges.—Nine bridges; 6 wood, 1 combination and 2 iron; with approaches. Spans 40 to 60 ft; iron spans 60 and 80 ft.; all with 16 ft. roadway. Bidders to submit plans and specifications. O. C. BELL, County Clerk, Lincoln, Neb. Aug. 20.

Water-Works.—Complete system for Superior, Neb. Direct pressure. Engineer, W. KIERSTED, Kansas City, Mo. GEORGE BROWN, Chairman Water Works Committee, Superior, Neb. Aug. 20.

Bridge.—High truss, steel or iron bridge; 150 ft. clear span, 14 ft. roadway, 100 lbs. per sq. ft. capacity. Over Mad river, near Medway. Bidders to furnish plans and specifications. O. F. SERVISS, County Auditor, Springfield, O, Aug. 20.

Pumping Machinery for Sale.—Proposals for purchase of Worthington engine of 3,000,000 galls. capacity, and two non-condensing direct acting engines of 1,800,000 galls. each. THE WATER BOARD, Boston, Mass. Aug. 22.

Retaining Walls.—Excavating soft material; refilling with sand or gravel, at the Cove basin. Plans and specifications on file. SAMUEL M. GRAY, City Engineer, Providence, R. I. Aug. 23.

Contracting.

Dam.—A masonry dam will be built at Roseburg, Ore., across the South Umpqua river. Engineer, W. S. HAMILTON, of Roseburg.

Cross Ties.—J. L. Kirkpatrick, of Green Cove Springs, Fla., has a contract for 25,000 cross ties for the Jacksonville, Tampa & Key West R. R.

The Chicago Electric Motor Co., to manufacture electric plant, has been incorporated by R. H. GARRIGUE, J. C. SCROGGS, J. H. CASWELL, and H. S. TIFFANY. Capital stock, $30,000.

Dredging.—The only bid received by the Dock Commissioners, New York, for dredging at Pier 61, was from the Atlantic Dredging Co.; 24 cts. per cu. yd. for mud, and $1.30 for hard mud, gravel, etc. The bid was rejected.

Asphalt Paving.—At Savannah, Ga., the City Council has accepted the bid of the National Vulcanite Co. for laying a pavement 8½ ins. deep on certain streets at $2.35 per sq. yd. The company will erect a plant in the city.

Disposal of Waste.—T. William Harris & Co., of New York, have been retained as Consulting Engineers by the Harvard woolen mills, and will endeavor to dispose of the waste and washings for those mills in a satisfactory and profitable manner.

Irrigation Ditch.—Wright & Wallace, of Lafayette, Ind., have been given the contract for the Kaskaskia ditch, in Champaign county, Ill., at $4,980. The work will be finished June 1, 1889. The proposed ditch will be 6 miles long, extending from Hensley township southward through the western part of Champaign township and into Tolono township.

Water Power Canal.—The St. Mary's Falls Water Power Co. has awarded the contract for the water power canal at Sault Ste. Marie, Mich., to McArthur Bros., of Chicago, Ill., theirs being the lowest of the 14 bids received. The canal is to be 100 ft. wide, with 9½ ft. of water, and is to be completed by August, 1889. The cost is estimated at $2,000,000.

Bridges.—The following contracts have been awarded by the New York Central & Hudson River R. R. Co.: Union Bridge Co., bridge over 4 tracks at 158th St., New York, 70 tons of open-hearth steel; also bridge over 4 tracks at 161st St., New York, 85 tons of open-hearth steel. The Hilton Bridge Co., of Albany, N. Y., has the contract for about 1,300 tons of iron for bridge repairs.

Bridge.—The following proposals for the construction of a wrought-iron bridge over the Lehigh river, have been received by the Commissioners of Northampton Co., Easton, Pa.: King Iron Bridge & Mfg. Co., Cleveland, O., $22,000; Mt. Vernon Bridge Co., Mt. Vernon, O., $22,900; Smith Bridge Co., Toledo, O., $24,300; Groton Bridge Co., Groton, N. Y., $24,900; Deane & Westbrook, New York, $27,800; Massillon Bridge Co., Massillon, O., $28,000; New Jersey Steel & Iron Co., Trenton, N. J., $29,100: Pittsburg Bridge Co., Pittsburg, Pa., $28,860, $31,850 and $35,800. The contract was awarded to the King Iron Bridge & Mfg. Co.

Cement, Sand, Etc.—The following proposals have been received by the Docks Commissioners, New York City: For 1000 barrels of Portland cement; James Brand, $2.20 per bbl.; Erskine W. Fisher, $2.28; Empire Warehouse Co., $2.35; Millen & Sons, $2.35; Marcial & Co., $2.38. ——For 10,000 ft. B. M. of 3-in. spruce; Joseph W. Duryee, $19 per M.; Wilson, Adams & Co., $20; Bell Bros., $22; Paul C. Coffin, $24.——For 500 cu. yds. of broken stone; John A. Bouker, $1.68 per cu. yd.; Brown & Fleming, $1.85.——For 250 cu. yds. of sand; Brown & Fleming, 74 cts. per cu. yd.; John A. Bouker, 75 cts. Contracts were awarded to the lowest bidders.

Retaining Walls.—The plans of City Engineer GRAY of Providence, R. I., for the retaining walls of the Woonasquatucket and Moshassuck rivers were approved on July 23. The sum of $450,000 is appropriated for this work, and its principal features are as follows: Retaining walls, 14 ft. high and 7 ft. 9 ins. wide at base, and 4 ft. at top, will be founded on sand and gravel filling; these walls will extend 12 ft. 8½ ins. above mean low water mark. Pile foundations will be used at points deemed necessary. The material employed in the walls will be heavy granite blocks in the base, and masonry above the water line of granite masonry laid in cement mortar. The probable quantities to be handled are: 124,900 cu. yds. dredging in mud; 83,950 cu. yds. sand or gravel filling; 1,528 cu. yds. riprap stone; 900 spruce piles; 210 cu. yds concrete around pile-heads; 18,250 ft. B. M. spruce capping; 8,460 cu. yds. rubble masonry in cement; 2,825 cu. yds. dry rubble masonry; 3,333 lin. ft. old coping to be set in cement. Bids will be received until Aug. 23.

Sidewalk.—The Park Commissioners, Buffalo, N. Y., have awarded to Peter G. Straub the contract for between 50,000 and 60,000 ft. of stone sidewalk. The contract will amount to $10,000 or $12,000.

New Croton Aqueduct.—The following proposals for work on Shaft No. 24 (former proposals for which were rejected June 14) were received by the Aqueduct Commissioners, July 3: O'Brien & Clark, $84,422.50; Charles Peterson, $85,020. The engineer's estimate is $84,547.50.

Swing Bridge.—The following proposals for the construction of a swing bridge at 106th St., Hyde Park, Ill., have been received by A. V. POWELL, Superintendent of Public Works: P. E. Lane, Chicago, Ill., $6,362; King Iron Bridge & Mfg. Co., Cleveland, O., $6,771; Wisconsin Bridge Co., Milwaukee, Wis., $6,982; Massillon Bridge Co., Massillon, O., $7,000; Milwaukee Bridge & Iron Works, Milwaukee, Wis., $7,300 and $8,000; Chicago Forge & Bolt Co., Chicago, Ill., $9,997.50 and $10,497.50; W. L. Coolidge & Co., Chicago, Ill., $10,555.

Sewers. — ***Chippewa Falls, Wis.*** — The city has awarded the contract for 2,935 ft. of 15, 18 and 24-in. vitrified pipe sewer, with 18 manholes and 26 catch basins, to Phelps & Abbott, of Minneapolis, Minn., for $15,675.

Brooklyn, N. Y.—Proposals for the construction of pipe sewers have been received by the Commissioner of City Works from John S. Bogert; 12 and 15-in. cement pipe, $1.60 and $2 per ft.; manholes, $40 each.

Hartford, Conn.—The following were the proposals for the sewers in Niles and Gillett streets: Michael O'Neil, $2,766.30; Joseph Prendergast, $2,940.25; Sylvester Bissell, $3,082.30. The contract has been awarded to Michael O'Neil.

Framingham, Mass.—The following were the proposals for the sewerage system: Jas. Killian, Boston, $30,190.75 (withdrawn); J. R. Rooke, Framingham, $32,028.73 (withdrawn); Sherman & McDonough, West Troy, N. Y., $40,358.15; William Whittaker, Boston, $43,659.41; Darcy & Linehan, $45,880.14; Metropolitan Construction Co., Boston, $47,208.40; Saucier and O'Mahoney, Framingham, $49,254.90; David Hall, $49,340.94; T. Wm. Harris & Co., New York, $51,001.35; H. B. Leach, New Jersey, $55,831.81; Howland & Ellis, Boston, $56,639.43; the latter bid including all the materials except manhole covers. The contract was awarded to Sherman & McDonough, whose bid was about $12,000 or $15,000 below the engineer's estimate. Mr. VAN VALKENBURG is the engineer in charge. H. L. Sawyer has the contract for drain pipe, amounting to about $12,000. The contracts for the pumping station, main conduit, etc., will be let later.

Street Work.—***Beatrice, Neb.***—The following proposals for paving Districts 1, 2 and 3, have been received by the Board of Public Works: *Paving;*—Beatrice brick on concrete; J. E. Riley, Omaha, $2.33 per sq. yd.; Christie & Lowe, Omaha, $2.15.——Beatrice brick on broken stone and sand; W. H. Duffett, Leavenworth, Kan., $2.20 or $2.25 for cash or bonds.——Beatrice brick on sand; W. H. Duffett, $1.80 or $1.85; Christie & Lowe, $1.83; Stout & Buckstaff, Lincoln, $1.84; J. E. Riley, $1.85.——Galesburg brick on concrete; Christie & Lowe, $2.35.——Galesburg brick on broken stone and sand; W. H. Duffett, $2.61 or $2.66.——Galesburg brick on sand; W. H. Duffett, $2.21 or $2.25; Christie & Lowe, $2.55.——Sioux Falls granite on concrete or sand; J. E. Riley, $3.25 or $2.68.——Sandstone on concrete, J. E. Riley, $3.20.——Sandstone on broken stone and sand; Christie & Lowe, $3.——Sandstone on sand; J. E. Riley, $2.63; Christie & Lowe, $2.50.——Cedar blocks on concrete; McAdam & Amberg, Chicago, $1.88½, including cement; A. J. McBean, Chicago, $1.83, including cement; J. B. & H. D. Smith, Chicago, $1.83, not including cement; J. E. Riley, $1.79 not including cement.——Cedar blocks on broken stone and sand, including cement; A. J. McBean, $1.79; J. B. & H. D. Smith, $1.61; McAdam & Amberg, $1.75.——Cedar blocks on sand and plank; A. J. McBean, $1.59, including cement; J. E. Riley, $1.39 not including cement, and 20 cts. extra for cement.——Cypress blocks on concrete; J. E. Riley, $1.65, not including cement.——Brick pavement 4 x 5 x 12, on sand; Stout & Buckstaff, $1.85.

Curbing.—Colorado sandstone, 5-in.; Christie & Lowe, 84 cts. per ft.; John Lanham, Crete, 86 cts.; J. E. Riley, 90 cts.; Stout & Buckstaff, 93 cts.——Colorado sandstone, 4-in.; Christie & Lowe, 76 cts.; J. E. Riley, 80 cts.——Berea sandstone, 5-in.; J. B. & H. D. Smith, 78 cts.; A. J. McBean, 78 cts.; J. E. Riley, 80 cts.; Christie & Lowe, 81 cts.; McAdam & Amberg, 85½ cts.; Stout & Buckstaff, 89 cts.; W. H. Duffet, 95 cts. or $1 for cash or bonds.——Berea sandstone, 4-in.; J. E. Riley, 70 cts.; Christie & Lowe, 73 cts.——Beattie limestone, 5-in.; A. J. McBean, 68 cts.; Christie & Lowe, 78 cts.; W. H. Duffet, 75 or 80 cts.——Mankato limestone, 5-in.; A. J. McBean, 78 cts.; Stout & Buckstaff, 80 cts.

The city has awarded contracts for brick paving to W. H. Duffet, of Leavenworth, Kan.; and for Colorado sandstone paving to Christie & Lowe, of Omaha, Neb. The manner of pavement construction is as follows, 6 ins. of sand; a layer of flat brick 2x4x8; a layer of edgewise brick 2x4x8. Upon the top course of brick an inch of sand is brushed in with a steel broom. This is thought to make a compact and durable pavement. The estimated cost of the paving is $144,000 and of the curbing $22,000. It will take 8,000,000 brick to do the work.

The Laidlaw & Dunn Co., of Cincinnati, O., has the contract for furnishing the pipe, fittings, valves, heaters, pumps, etc., for the new works of the Addyston Pipe & Steel Co., now being erected at Addyston, O.

Macadamizing.—The following bids for macadamizing Jackson Ave. were received by JOHN J. MCLAUGHLIN, C. E., of Brooklyn, N. Y.: J. F. Gillen, 233 Myrtle St., Brooklyn, $21,000 (withdrawn); Frank Monteverde, Newtown, $21,700; J. W. Phelan, 2,011 7th Ave, New York, $22,000; L. H. Burden, Long Island City, $24,941; Bernard Mahon, 2,293 7th Ave., Brooklyn, $35,000; W. E. Warren, Yonkers, N. Y., $35,523.45. The contract has been awarded to Frank Monteverde.

Railroad Contracts.—***Chowan & Southern.***—The contract for the construction of this Virginia road, which has been purchased by the Richmond & Danville, has been let to the American Construction Co.

Louisville & Nashville.—The contract for the construction of the Cumberland Valley branch, from Pineville, Ky., to Cumberland Gap, Tenn., has been awarded to Serpell & Morris, of Louisville, Ky.

Georgia Central.—The contract for the construction of the Buena Vista & Ellaville extension from Buena Vista to Columbus, 33 miles, has been awarded to the Chattahoochee Brick Co., of Atlanta, Ga. The work is to be completed by January.

Birmingham Mineral.—The contract for the construction of 19 miles of the Huntsville extension has been awarded to J. W. Worthington & Co., of Birmingham, Ala.

Waco & Brazos Valley.—The contract for grading from Waco, Tex., to Cameron, has been awarded to Joseph Branner, of Houston, and F. F. Jones, of Waco.

Columbia Canal.—The following are the totals of the proposals for work on the enlargement of the Columbia Canal, received by BYRON HOLLEY, Chief Engineer, at Columbia, S. C.:

Bidders.	Mechanical Structures		Section Work.
	With Stone Dam	With Crib Dam.	
John Satterlee & Co....	$102,775.50	$90,080.75	$105,191.00
Smith & Brown	122,844.50	80,077.50	131,788.00
Rice & Coleman.	112,349.50	92,736.25	103,047.00
James D. Harden			69,440.00
Stuart, Sullivan & Co...			75,487.00
Samuel R. Adams.....			103,596.00
A. R. Eskridge & Co....			126,337.50

John Satterlee & Co. and Smith & Brown, of New York, bid upon both schedules, declining however to accept an award of either singly. Rice & Coleman also bid upon both, but without conditions. The contract for mechanical structures, with crib dam, was awarded to Rice & Coleman, of Union, S. C., at $92,736.25. The contract for section work was awarded to James D. Harden, of Sumter, S. C., at $69,440. The mechanical structures include dam, abutments, bulkhead, lock, culvert, waste weir, and a section 400 ft. long at location of bulkhead. The quantities and contract prices are as follows:

Mechanical Structures.—Bailing and draining, complete, $3,000; grubbing and clearing, complete, $100; 16,000 cu. yds. earth excavation, 25 cts., $4,000; 1,000 cu. yds. solid rock excavation, $1, $1,000; 500 cu. yds. loose rock excavation, 75 cts., $375; 1,000 cu. yds. embankment, 20 cts., $200; 500 cu. yds. puddling, 20 cts., $100; 2,750 cu. yds. lining, 30 cts., $825; 500 cu. yds. slope and riprap walls, $1.55, $775; 50 cu. yds. vertical or battered walls, dry, $2.75, $137.50; 100 cu. yds. ditto in cement, $4, $400; 6,325 cu. yds. masonry in cement, $8.25, $52,181.25; 25 cu. yds. masonry in stone arches, $15, $375; 125 cu. yds. masonry in brick arches, $8, $1,000; 200 cu. yds. concrete masonry, $4, $800; 3,100 cu. yds. loose stone in cribs, $1.75, $5,332; 161,000 ft. B. M. yellow pine in work, $20, $3,220; 240,000 ft. B. M. yellow pine in cribs, $22, $5,280; 240,000 ft. B. M. other timber in cribs, $20, $4,800; 56,450 lbs. wrought iron in work, 8 cts., $4,516; 60,000 lbs. cast iron in work, 6 cts., $3,600; 2,500 spikes and nails in work, 3½ cts., $87.50; 4 sets of composite valves, $80, $320; 50 lbs. sulphur in cement, 5 cts., $2.50; 46 squares shingling, $3.25, $149.50; 800 sq. yds. painting and sanding, 20 cts., $160. Total, $92,736.25.

Section Work.—Bailing and draining, complete, $2,000; grubbing and clearing, complete, $100; 402,000 cu. yds. earth excavation, 10½ cts., $42,210; 6,000 cu. yds. solid rock excavation, 75 cts., $4,500; 4,500 cu. yds. loose rock excavation, 40 cts., $1,800; 13,000 cu. yds. embankment, 15 cts., $1,950; 7,500 cu. yds. puddling, 8½ cents, $637.50; 11,500 cu yds. lining, 8½ cts., $977.50; 7,500 cu. yds slope and riprap walls, $2, $15,000; 50 cu. yds. vertical or battered walls, dry, $2, $100; 100 cu. yds. loose stone, 75 cents, $75; 4,000 ft. B. M. timber in cribs, $18, $72; 200 lbs. wrought-iron in work, 6 cts., $12; 100 lbs. spikes and nails in work, 6 cts., $6. Total, $69,440.

Brooklyn Federal Building.—The following proposals for the construction of the Post Office and Federal Building, Brooklyn, N. Y., were opened July 23 by the Supervising Architect of the Treasury, Washington, D. C.: John Moore, totals, white oak finish, $880,000; mahogany, $895,000; cherry, $885,000.——John H. O'Rourke: masonry, $309,000; iron work, $230,000; interior finish, white oak, $286,000; mahogany $309,000; cherry, $288,000; total $927,000.——E. F. Gabel: masonry, $228,989; iron work, $149,388; interior finish, white oak, $230,147; mahogany $255,557; cherry, $245,477.——B. Gallagher, total, $851,000.—— K. A. Murphy: masonry, $440,000; iron work, $250,000; interior finish, white oak, $480,000; mahogany, $500,000; cherry, $480,000; total $1,170,000.——William Lamb, totals, white oak, $821,145; mahogany, $839,145; cherry $833,145.——F. P. Wight & Co., iron work, $229,662.85.

Filling and Bridge Work.—The Trustees of the Cincinnati Southern R. R. Co. have received the following bids for the filling to be done in Millcreek bottoms and the bridge to be built over Gest St. at Cincinnati, O.: Big Four Railroad Company, per General Manager. WM. GREENE, 35 cts. per cu. yd. The bid was only on the work of making the fill of which there will be about 70,000 cu. yds.

Murray & Son, Cincinnati, 2,000 cu. yds. excavation for bridge foundation, 30 cts. per cu. yd.; 350 cu. yds. bridge masonry, $7 per cu. yd; 68 cu. yds. box culvert, $5.10 per cu. yd.; 35 cu. yds. concrete, $5.25 per cu. yd.; 7,500 ft. white oak lumber, $27 per 1,000 ft. The above bids are for the bridge work.

J. H. Stewart & Co., Portsmouth, O.; hill limestone, $5.50 per cu. yd; dry earth excavation, 25 cts. per cu. yd.; timber, $25 per 1,000 ft.; concrete, $5 per cu. yd. For first-class freestone masonry, $7.25 per cu. yd.

P. N. Jonte, Cincinnati, embankment excavation, 38 cts. per cu. yd; foundation excavation, 65 cts. per cu. yd.; bridge masonry, $8 per cu. yd.: box culvert, $5 per cu. yd.; concrete, $6 per cu. yd.; white oak timber, $30 per 1,000 ft.

Madison, Garrettson & Co., Cincinnati: embankment excavation, 60 cts. per cu. yd.; foundation, $1.25 per cu. yd.; masonry, $8 per cu. yd.; culvert masonry, $3 per cu. yd.; concrete, $3 per cu. yd.; oak timber, $35 per 1,000 ft.

The bids were referred to Chief Engineer CABELL BRECKINRIDGE, for calculation and report. The work on which the bids were made is to be paid for from the funds for terminal purposes remaining in the hands of the trustees.

Bridges & Canals.

Allegheny Suspension Bridge.—The Allegheny Suspension Bridge Co., of Pittsburg, Pa., is having a thorough inspection made of the bridge and anchorages. Col. ROEBLING, the engineer for the company, has recommended the inspection, as it is about 30 years since the bridge was completed. W. HILDEBRAND, C.E., is in charge of the work.

St. Louis Bridge.—The Merchants' Terminal Bridge scheme, which was defeated about a year ago by JAY GOULD, has been revived, and some progress is said to have been made in floating the stock. The plan is to build a bridge in North St. Louis, across the Mississippi river, to give terminal facilities to several additional railroads now seeking an entrance to the city, and remove the heavy toll imposed upon the commerce of the city by the present lessees of the Gould bridge. A charter for the new bridge was obtained two years ago from Congress, and the city has given all the necessary right of way. Mayor FRANCIS, JOHN D. PERRY, Major C. C. RAINWATER, and other capitalists are at the head of the enterprise.

Drawbridge.—The San Francisco & North Pacific R. R. bridge, crossing Petaluma creek on the New Napa and Marin line, is 3,100 ft. long, consisting of 2,874 ft. of wooden trestle work and a drawbridge of steel and iron 226 ft. long, allowing two openings of 100 ft. It is the first steel and iron draw span for railroad use, constructed entirely in bridge shops located on the Pacific coast, being turned out by the California Bridge Co. at Oakland, Cal. The pivot pier consists of four clusters of piles. Each cluster, containing 19 piles varying from 90 to 110 ft. in length, is incased by an iron cylinder 9 ft. in diameter at the bottom, and 7 ft. 6 ins. diameter at the top. The plates are ¾-in. thick. The cylinders were brought to a solid bearing, and are braced together. The bridge was designed and built by the California Bridge Co., A. W. BURBELL, President; and the work was carried out under the direction of F. K. ZOOK, Chief Engineer of the San Francisco & North Pacific R. R.

Sault Ste. Marie Canal.—The St. Mary's Falls Water Power Co. has elected the following officers: President, JOSEPH CLARKE; Vice-President, S. J. CORGILLS; Secretary, E. W. ELLIS; Treasurer, WILLIAM CHANDLER. The Board of Directors are: W. W. CORGILLS, S. J. CORGILLS, JOSEPH CLARKE, WILLIAM CHANDLER, OTTO FOWLE, W. A. STOWELL, E. W. ELLIS. With the exception of CHANDLER and FOWLE the officers are all from La Crosse.

Bridge Notes.—***Fairmount, R. I.***—The wooden bridge of the Providence & Worcester R. R. is to be replaced with an iron bridge.

Holyoke, Mass.—A new bridge is to be built across the Connecticut river between Holyoke and South Hadfield Falls. It will be an iron bridge with a 30-ft. roadway and two 6 ft. sidewalks. The plans were prepared by Engineer SHAW, of the Boston Bridge Co.

Brooklyn, N. Y.—The Kings Co. Board of Supervisors has appropriated $1,200 for a new drawbridge over Newtown creek at Grand St., to replace the present dilapidated structure. A committee has been appointed to confer with the Queens Co. authorities and to prepare plans and specifications.

Beaver, Pa.—The Sharon Bridge Co. has let all the contracts for its bridge across the Beaver river at the mouth of Brady's run, and the structure is to be completed in 4 months. The Bridgewater Ferry Co. has asked for an injunction to prevent the construction of the bridge.

Parkersburg, W. Va.—The Little Kanawha bridge which was recently washed away, will be rebuilt by E. B. Henderson, of Marietta.

Eutawville, S. C.—The Santee River bridge of the Eutawville R. R. will be completed shortly. It will be about 600 ft. long; with four spans, one of which will be a draw.

Charleston, S. C.—Work has been commenced on the bridge across the Cove to Sullivans island, for the Mt. Pleasant & Seaview R. R. It will be a double track bridge and will have a 50-ft. draw.

Montgomery, Ala.—A bridge across the Alabama river is projected. It is proposed to build a highway and railway bridge, the estimated cost being about $100,000, which would be divided between the city, the railroad company and Autauga, Elmore and Montgomery counties.

Huntsville, Ala—The Birmingham & Huntsville R. R. is said to intend building a suspension bridge across the Tennessee river.

Shreveport, La.—The Vicksburg, Shreveport & Pacific R. R. Co. will build a bridge over its tracks at Gary St.

Kappa, Ill.—The Illinois Central R. R. will repair the bridge and piers of the Mackinaw bridge.

East St. Louis, Ill.—The new iron bridge over Cahokia creek, at St. Clair Ave., has been rendered impassible by the failure of one of the piers. The bridge cost about $8,000, and had been accepted.

Chicago, Ill.—Work on the bridge of the Chicago, Madison & Northern Ry. (Illinois Central) over the Des Plaines river near Chicago, is progressing rapidly and will soon be finished.

Minneapolis, Minn.—Work is progressing on the Lake St. bridge. It was to be completed by Aug. 1, but has been delayed for want of material owing to the strikes in the East. An extension of time has been granted.

Portland, Ore.—The Portland & Vancouver Ry. Co. has offered to rebuild the Fourth St. bridge, and make it higher, wider and stronger.

Red Rock, Ariz.—The Atlantic & Pacific R. R. will build an iron bridge across the Colorado river. It will be 800 ft. long and will cost about $90,000.

Belton, Tex.—The County Commissioners will build another bridge across the Leon river.

Coteau, Ont.—The Canada Atlantic Ry. will begin work at once on its bridge across the St. Lawrence. Resident engineer MOUNTAIN will be in charge. The contractor is James King, of Valleyfield.

Montreal, Canada.—The new iron swing bridge over the canal above Lachine has been completed by the Montreal Bridge Building Co. at a cost of $5,000, including timber and masonry. It is 82 ft. long and 18 ft. wide.——A wooden bridge, 80 ft. long and 24 ft. wide has been built over the canal at No. 3 lock.——The C. P. Ry. proposes to cross Mountain St. by a stone bridge of two spans, with a 6 ft. pier in the middle of the road. The residents want an iron bridge with columns on the curb line.

WATER.

Mazatlan, Mexico.—The surveys and preliminary work for the water-works are being completed. The water will be brought to the city through 19½ miles of 14-in. wrought-iron pipe. It is expected that the iron will come from England.

Chattanooga, Tenn.—On July 17 the City Council repealed the ordinance passed in 1887 creating a Board of Public Works. This action was brought about by the resignation of Superintendent HOOK, of the Board of Public Works, and the fact that the street and sewer fund is exhausted. Hereafter these funds will be under the direction of the city engineer.

Buffalo, N. Y.—The Board of Health has received a report on the dangerous condition of the water in the Main and Hamburg canals, which is polluted with sewage and refuse from factories and mills. The canal is said to be a stagnant ditch, and its condition is denounced as a "gigantic, dangerous and shameful nuisance."

The Electric Storage Battery Co. has been incorporated at Camden, N. J., in the County Clerk's office, with a stated fully paid up capital of $10,000,000. Of that amount $2,500 was paid in cash and $9,997,500 is claimed to have been paid for patent rights necessary to carry on the business.

Jersey City, N. J.—At the meeting of the Board of Public Works, July 23, a communication from C. W. FULLER, City Counsel of Bayonne, was received protesting that the water furnished by Jersey City to Bayonne was unfit for use. It is the same water used by Jersey City. The Board of Public Works decided to give the people of Bayonne a hearing in the matter.

Philadelphia, Pa.—T. William Harris & Co., engineers & contractors, New York City, have been awarded the contract for laying the mains for fuel gas at Tacony. This is but the beginning of a great work of furnishing the city of Philadelphia with a cheap and economical fuel gas, generated by the Loomis process.

Brooklyn, N. Y.—After many months of delay the Brooklyn Aldermen took a step on July 23 toward solving the problem of an increase in the city's water supply, by authorizing the Mayor, Controller, and City Clerk to issue bonds not exceeding $1,200,000 for the purpose of enlarging the Ridgewood reservoir. The money will be spent in the following manner; reservoir, $550,000; engine house, pumping engines, and new force main, $350,000; driven wells at Baisley's pond, $200,000; repairs of conduit at same place, $100,000. These improvements will double the capacity of the reservoir and will require 2 years to complete.

Irrigation in California.—The Madera Irrigation District has been organized under the Wright irrigation law which authorizes the people to organize irrigation districts. Water will be taken from the San Joaquin river for irrigating 300,000 to 400,000 acres of land. O. T. REDFIELD, of Madera, is interested. The present system is a private enterprise owned and controlled by four men; when water is plentiful they sell it to others, but when it is scarce they use it all for their own purposes.

Colusa.—The Colusa Irrigation District has been organized under the Wright irrigation law.

Anaheim.—The Anaheim Irrigation District is also to be organized under the same law. These irrigation projects are favorably considered by the people.

Water-Works. — ***Maine.***—Skowhegan. The embarrassment of the contractor may delay the works, but it is hoped they will be completed this season.

New Hampshire.—Laconia. The draught on the reservoir of the Laconia and Lake Village water-works is very large, the daily consumption being over 400,000 galls., requiring 70 hours pumping each week to keep up the supply.

Massachusetts.—Lee. It is proposed to put in a number of hydrants.——Mansfield. The stand-pipe is being erected and the works are expected to be in operation in 2 months.

Rhode Island.—Newport.—At the recent annual meeting of the stockholders of the water-works, the following officers were elected: President, GEO. H. NORMAN; Secretary, ROBT. S. FRANKLIN; Treasurer and Superintendent, WM. S. SLOCUM.

New York—Lyons. The water company will have 4 more wells drilled near the reservoir; B. F. Lockwood has the contract.——Fulton. The water-works have been tested and found satisfactory.——Oswego. A contract for water-works will probably be made on the terms proposed by the committee of the Council; $15,000 per year for 15 years.

Pennsylvania,— Pittsburg. The Council has passed the ordinance granting a franchise to the Duquesne Water Co. The company will have an exclusive right to supply water for elevations for 30 years.——Media. The boiler of the water-works burst July 23, and consumers have been notified to be economical in the use of water. The reservoir was about half full when the accident happened.——Lancaster. Contractor Frank Hinden has finished the work of laying the 36-in. main to connect the new water-works with the reservoir.——Braddock. A contract has been made for water-works, at a cost of $9,800.——Everett. Water-works are projected.

West Virginia.—Wellsburg. The Water Board has purchased a new pump, with a daily capacity of 1,000,000 galls.

Kentucky.— Covington. The water-works bonds are not yet sold, and it is suggested that the Council should take them from the commissioners and sell them.

Tennessee.—Pulaski. The city has voted to build the water-works.—— Chattanooga. Water-works to supply the suburbs will be built by ROBT. MORRISON and others.——Bristol. A contract for water-works has been made with W. W. TAYLOR, of Philadelphia, Pa. The supply will be brought from King's spring, about 2 miles distant, and the works will have a capacity for a population of 20,000.

Georgia.—Hinesville. The Hinesville Water-Works Co. will use a water wheel to pump water from a mineral spring to a reservoir.——Fort Valley. Water-works will be built by the Georgia Steam & Gas Pipe Co., of Columbus, Ga. The water will be brought from a spring 2½ miles distant and there will be a stand-pipe and 8 hydrants.

Florida.—Key West. The Key West Water Supply Co. has been incorporated at East St. Louis, Ill., by FRANK CARTER, JAMES N. NORRIS, SIMEON PARKER, and T. G. RUSSELL. Capital stock, $200,000.——De Land. It is proposed to issue bonds for $50,000 for water-works and sewerage. Address SILAS B. WRIGHT.——Starke. Water-works are projected.

Alabama.—Jacksonville. The town has a water supply by gravity from a mountain spring 2 miles distant, to a reservoir on an elevation in the town. In the town there is also a spring flowing 3,000,000 galls. per day.

Illinois.—South Chicago. The Board of Trustees propose to expend $75,000 on additional pumping plant.——Morrison. The Jacobstown Water Tower Co. has been incorporated by SAMUEL TAYLOR, LEANDER SMITH and H. R. SAMPSON. Capital, $10,000.

Wisconsin.—Janesville. The new works were tested recently; the pressure from the reservoir throws fire streams to a height of 100 ft.

Kansas.—Wichita. The Fairmount Water Co. has been incorporated by A. A. HYDE, GEO. C. STRONG, J. W. PARSONS and PETER GETTO. Capital stock, $50,000.

Missouri.—St. Louis. The Council has unanimously passed the bill to retain the low service works at the Chain of Rocks and to construct a conduit to connect with the high service engines. This effectually defeats the Meramec springs scheme.

Colorado.—Antonito. The Taos Valley Co. will lay 10 miles of pipe to convey a supply of water from the Conejos river for domestic and fire purposes.

Nebraska.—Lincoln. There has been trouble of late owing to insufficient pressure, which has been very serious at fires. The pumping plant is inadequate for the demands.——Fremont. A vote on the issue of $35,000 bonds for water-works extensions and sewers will be held July 30.——Superior. A direct pressure system is to be established and bids will be received until Aug. 20. W. KIERSTED, of Kansas City, Mo., is the engineer.

Oregon.—Baker City. The contract for water-works will be awarded Aug. 15.

Nevada.—Tuscarora. The Tuscarora Water Co. has been incorporated by THOS. BELL, DANIEL MEYER, J. T. CASSELL, P. C. HYMAN and S. C. BIGELOW. The water will be pumped from Taylor canon, 12 miles distant, with a head of 200 ft. The supply will be 1,000,000 galls. per day.

Washington Territory.—Ellensburg. The Capital Hill Water-Works Co. has been incorporated by B. E CRAIG, S. E. CRAIG and C. A. LANDER. Capital stock, $50,000.——Spokane Falls. The city has leased from the Spokane Mill Co. an island in the river as a site for the new water-works. The lease runs for 5 years at $1,000 per annum.

California.—Benicia. Water-works will be built by the San Francisco Tool Co.

Texas.—Dallas. It is proposed to obtain a water supply from Hurst Lake, which is supplied by an artesian well.——Waxahachie. Water-works are projected and a committee composed of E. A. DUBOSE and J. F. STRICKLAND has been appointed to visit other cities and report on the best system.——Colorado. Fletcher & Caldwell, lessees of the water-works, will put up a 30-ft. wind power pump.——Victoria. The town is supplied with water from the Guadalupe river. There are 4¾ miles of pipe, 46 hydrants and a stand-pipe 100 ft. high by 16 ft. diameter with capacity of 150,000 galls. The pumping plant has a daily capacity of 1,000,000 galls. and gives a pressure of 150 lbs.

Electric Lighting. — ***Bucksport, Me.*** The electric light plant is in operation, and there will soon be 300 lights. C. S. HOMER is manager.

Sullivan, Me.—The Sullivan Harbor Land Co. will establish an arc and incandescent plant on its property. It is proposed to utilize the tidal current for motive power.

Orange, Mass.—The Selectmen have made a contract with the Thomson-Houston Electric Light Co. to light the streets for the rest of the year at $82.50 each for 21 arc lights.

Newport, R. I.—The Narragansett Electric Light and Power Co. has been incorporated. President EDWARD EARLE. The Thomson-Houston Co. is represented by T. G. ROBINSON, of Boston.

Rockville, Conn. — The Thomson-Houston Co. has made a proposition to put in an electric light plant.

Allegheny, Pa.—The city has granted ordinances to the Allegheny Electric Light Co., and the Duquesne Electric Light Co. The latter company will erect poles in the city and also lay five miles of underground cable.

Delavan, Ill.—The Delavan Electric Light Co. has been incorporated by J. M. ALLEN and F. E. ALLEN. Capital stock, $6,000.

Englewood, Ill.—The Englewood Electric Light Co. has been incorporated by Jos. BADENOCH and C. T. PAGE. Capital stock, $50,000.

Normal, Ill.—It is proposed to adopt an electric light system.

Lexington, Mo.—A proposition to establish an electric light plant has been made by E. ABENDROTH.

Aurora, Neb.—An electric light system is to be established.

Ellensburg, Wash. Ty.—The Ellensburg Electric Light & Power Co. expects to have its arc and incandescent light plant in operation by October.

Colfax, Wash. Ty.—The Colfax Electric Light Co. will put in its plant at once. J. H. PERKINS, President; C. B. HOPKINS, Secretary.

Walla Walla, Wash. Ty.—The Walla Walla Electric Light & Power Co. will put in its plant at once.

Paris, Tex.—The Paris Gas & Electric Light Co. will spend about $30,000 in enlaring the gas works and putting in an incandescent electric light plant.

Beatrice, Neb.—The city has been petitioned not to enter into a contract with an electric light company for lighting the city, but to put in a plant of its own, to be run in connection with the water-works. It is estimated that thirty lights can be run for the price asked for fifteen.

New Orleans, La.—The Brush-Westinghouse electric plant on Dryades St. was burned July 16. The loss is estimated at $100,000. The city hall, parish prison, police stations and levee were furnished with light from this plant.

Burlington, Ia.—The Burlington Edison Electric Co. has been incorporated to establish and operate electric light and power plants. President, EDWARD HAGEMANN, Manager, C. J. REED.

Helena, Mont.—The city has recently brought suit against the Hale water company, under the provisions of an ordinance which provides that water companies must execute a bond for $25,000 and must use iron pipe. The company has been supplying water through wooden pipe since 1865, and the pipes were laid before this ordinance was passed; its enforcement would impose upon the company an expense of $75,000 which would cause the company to shut down. The trouble with worms in the water last year was due to stagnant water in the reservoir and not to the wooden pipes, and alterations have been made which will obviate this trouble in future. The matter has been considerably discussed in councils and a new ordinance has been passed amending the original water ordinance by striking out the section forbidding the use of wooden water pipes and conduits, and also the section requiring the bond of $25,000.

The Woolston water-works company is putting in a second pump, which will greatly increase the capacity of the works. The pump has been sent from Boston.

Jersey City, N. J.—The committee of 100 citizens which was organized some time ago for the purpose of working to prevent the city authorities from purchasing, or leasing a new water supply, appointed a sub-committee to look after the work. The sub-committee has prepared a report, which in substance is as follows:

"We have carefully examined the vital statistics of Hudson Co. for the past 10 years and find that there has been an almost steady decrease in deaths from zymotic diseases. We also find that the number of deaths from diarrhœal diseases (it is universally admitted that such diseases are largely caused by impure water) is much larger in those portions of the county that are not supplied with Passaic water, viz., the towns of West Hoboken, Union Hill, North Bergen, Weehawken and Union township, the rate being nearly 3, while in Jersey City it is but 1.5. We are of the opinion that until the city feels warranted in procuring water from its sources by gravity, that the present water should be filtered before it is run through the pipes. A system of filtration at Belleville would be inexpensive, and, we are confident, would remove many, if not all, of the objections to the water now used."

Newark, N. J., Water Supply.—The Joint Committee of the Common Council and the Aqueduct Board appointed to consider the subject of a new water supply submitted a series of questions to Mr. J. A. BARTLETT, of the Bartlett Water Co., to which he has returned a long reply, setting forth that he would be willing to sell water privileges to the city for Newark alone, the city to construct its own works and conduit; that he would be willing to enter into a 10 years contract, but on not as favorable terms as for a 25 years contract; that he would give the city at the expiration of the contract the option of buying the plant and additional water privileges to the extent of 50,000,000 galls. daily. He adds:

"I propose to take water for the city of Newark from the upper tributaries of the Passaic river, but it is impossible to fix definitely from what point the supply for Newark should be drawn until more definite understanding is arrived at in regard to the other questions propounded; but I will undertake to guarantee that the water furnished shall be pure and wholesome and of a satisfactory character to you, and will be taken from a point of sufficient elevation to deliver the water by gravity to your distributing reservoir."

He also says he does not propose to furnish water that will require filtering. The water will be guaranteed to be of satisfactory purity and suitable for public use.

Mr. BARTLETT also says that to determine the cost of the water involves in addition to the cost or annual rental the consideration of the cost of storage reservoirs on the upper tributaries of the Passaic capable of holding at least 12,000,000,000 galls., in order to give a supply of 50,000,000 galls. daily during the dry season. The cost of these reservoirs and the cost of diversion of the waters would be about $5,000,000. In carrying out this plan the city would be anticipating future wants for the next 40 or 50 years. There are two sources on the Passaic watershed where the amount of 50,000,000 galls. daily supply can be secured of satisfactory purity. The first is the western system, including the Rockaway river and its tributaries, and embracing the water flowing from Lake Hopatcong, now controlled by the Morris Canal Company lessees. The other source, from which the Morris canal also draws, is the northern system, that part of the Passaic watershed which embraces the Pequannock, Wynockie and Ramapo rivers and their tributaries. The surplus waters of these rivers would have to be stored in reservoirs built on said tributaries of sufficient capacity to store the surplus or flood waters for delivery during the summer season or season of least flow, in order to secure to Newark a continuous daily supply throughout the whole of the year. Without such reservoirs there would be no water available during the summer season. He adds:

"We would be unwilling in the light of the knowledge that our researches and investigations the past few years have revealed to name any time less than 3 years from date of contract in which to build the large reservoirs, aqueduct and pipes necessary to deliver a maximum amount of 50,000,000 galls. daily, and take the risks of delays occasioned by storms and unknown obstacles. But this you can be assured of, that we are in a position to commence work of construction immediately on execution of the contract. If reservoirs and works are built only to store or deliver 25,000,000 or 30,000,000 galls. daily the time occupied in their construction would be less than 3 years."—*Newark Advertiser.*

Special Reports of Water-Works Construction.

THE ENGINEERING NEWS MANUAL OF AMERICAN WATER-WORKS is now being compiled, and will be *indispensable* to every manufacturer, engineer and contractor in any way interested in Water-Works construction and maintenance, and will be of great value to Water Works superintendents and projectors of new works.

Superintendents of water-works and water companies will wish to see correct and complete data concerning their Works in our MANUAL, and to ensure this they should send in reports *at once* upon the blanks which we have already sent to every Water-Works office in the United States and Canada. Many have delayed their report, and if the blanks we intended for them have been lost in the mail, or mislaid, we will send more upon request.

We *must* have a report from every public water-supply system in North America, so those who reply to our inquiries at once will save a second inquiry. We also wish to know of *every* new Water-Works plant in process of construction, and of *every* new project in this line. We will send to any one desiring them, blanks upon which reports can be made.

Further details of the MANUAL will be advertised later. We abstract from our special reports for the MANUAL the following items of current interest:

PITTSBURG, Pa., July 13, 1888.

EDITOR ENGINEERING NEWS:—I enclose you a description of the water-works which we have recently built at Wahoo, Neb., in answer to your inquiries and endeavors to furnish the public with the history of the water-works lately constructed.

W. S. KUHN, *Gen. Man., Am. W. W. & Guarantee Co.*

The city of Wahoo, Saunders Co., Neb., lies about 35 miles west of Omaha, on the line of three railroads, viz.: the Fremont, Elkhorn & Missouri Valley, the Burlington & Missouri river, and the Omaha & Republican Valley. Although laid out only twelve years ago, it has accomplished a growth quite remarkable. It now has a population of about 44,000, with numerous business blocks, four banks, schools, churches and large flouring and milling interests. The farming lands near the town are very productive and are held at good prices.

The necessity for a permanent and reliable water supply for general use and for fire protection came to be felt, and in accordance with that sentiment the Wahoo Water Works Co. was organized in August, 1887, with a capital stock of $125,000. A majority of the stock having been taken by the American Water-Works & Guarantee Co., limited, of Pittsburg, Pa., that company made a contract with the local water company to construct the works. The city council passed an ordinance granting a liberal franchise, and work was commenced about September 1, 1887, and pushed with vigor until obliged to stop for the winter season. Sufficient work was, however, accomplished in the Fall to afford ample fire protection to the business portion of the city. The system when completed will consist of 7 miles of cast-iron pipe, ranging in size from 10 to 4 ins. in diameter, with at present 43 double discharge fire hydrants (Matthews patent) properly spaced, for which the city will pay an annual rental of $70 each, and stop valves so arranged at street corners that small sections of the system can be shut off for repair. The system of supply is that of direct pressure, the water being taken from drive wells on the bank of Wahoo creek, and so far as tested being abundant in quantity and excellent in quality. There are two Walker pumping engines, each having a capacity of 1,000,000 galls. in 24 hours. A brick pump house of handsome architectural design encloses the pumps and boilers, and is an ornament to the city. The entire works will be completed and in successful operation about August 1, of the present year, at a cost of about $65,000.

FORT RILEY, Kan., July 1, 1888.

EDITOR ENGINEERING NEWS: This is a military post and the works described are for supplying the garrison of 1,500, and are built under my direction. The supply will be pumped from Wagner steamed wells near the Republican river to a reservoir of 500,000 galls. capacity. The pump will be a Deane, compound, duplex, 14 x 20 ins. steam cylinder, 10¼ in. water cylinder, 18-in. stroke, with a daily capacity of 1,000,000 galls. There will be four miles of pipe and an ordinary and fire pressure of 60 lbs. The works will cost $44,500. They were designed by Prof. J. B. JOHNSON, of St. Louis, Mo., and W. H. STAIR, is Constructing Engineer. Jno. Dwyer, and G. W. Pearsons, Kansas City, Mo., are the contractors. GEO. E. POND, *Assist. Quartermaster, U. S. A.*

MEDFORD, Ore., June 26, 1888.

EDITOR ENGINEERING NEWS:—Our proposed water-works are for fire protection, that being all we need. Water will be pumped from a creek to a reservoir, the power being taken from a flowing well. The cost is estimated at $5,000. J. S. Howard, of this place, is the contractor. Work will begin in July and be finished in January, 1889. S. S. PENTZ, *City Attorney.*

W. R. COATS, Chief Engineer of the Kalamazoo, Mich., water-works, writes that he has just finished the construction of a second well for the works, which are on the direct pressure system. The ordinary daily consumption reached 3,500,000 galls. last summer, and though the well would have supplied 500,000 galls. in addition, it was deemed unwise to have so small a margin for fire protection, as 3,000,000 galls. might be needed in addition to the regular supply. The new well is a success. Mr. COATS spent last winter developing a water supply for Santa Barbara, Cal., and is now in San Diego, Cal., designing an additional supply for that city.

The water-works of Elko, Nev., are owned by the HI HAY Water Co., and superintended by HI HAY. This is the only Chinese water company in America of which we know. HI HAY has charge of 3,500 ft. of pipe, and a 4,600 gall. reservoir. His works were begun in 1872 and finished 1873. They cost $2,740 and there is no debt upon them. He employed an engineer, named ROBT. CULLEN, to design and construct the works. The population of Elko is 750.

Further details concerning the works are not given—neither are HI HAY'S laundry prices.

RECORD OF NEW WATER-WORKS CONSTRUCTION.

(*Specially Communicated.*)

(CONTINUED FROM PAGE 58).

National City, Cal.—The works were commenced in November, 1886, and completed in February, 1888. The engineer was JAS. D. SCHUYLER Chief Engineer of the San Diego Land & Town Co., National City. The works were built by the company; the pipe and specials were furnished by the National Tube Works, of McKeesport, Pa., Abendroth, Root & Co., of New York, and the Risdon Iron Works of San Francisco, Cal.; the valves and hydrants were furnished by the Risdon Iron Works. The supply is by gravity, and the water is taken from the Sweetwater river and a reservoir formed by a masonry dam 90 ft. high. (This dam has been described and illustrated in ENGINEERING NEWS). The reservoir covers an area of 720 acres, and has a capacity of 6,000,000,000 galls. There are 63½ miles of pipe and 200 taps; the mains are of wrought-iron and the services of galvanized iron. Average daily consumption, 2,000,000 galls. Ordinary pressure, 60 to 80 lbs. The cost of the dam was $33,049, and for the pipes $502,763.85; total cost of works, $735,812.85. There is no debt. The works supply National City and Chula Vista, a suburban residence district of 5,000 acres, in which the smallest lot is five acres), and water for irrigation in the Sweetwater valley and the mesas adjacent to National City, San Diego and Chula Vista. The works are owned by the San Diego Land & Town Co., of Boston, Mass., which has a capital stock of $2,250,000, covering land, railroad, water-works and other enterprises. WM. S. DICKINSON is General Manager. The population of the city is about 6,000.

Fredonia, Kan.—The works were commenced in June, 1887, and completed in November, 1887. They were designed by JAS. O'NEIL, who also took the contract for construction. The buildings were put up by John S. Huntley, of Cherry Vale, Kan.; the pumping machinery was furnished by the Deane Steam Pump Co., of Holyoke, Mass., the pipe and specials by Ripley & Bronson, of New York, and the Chattanooga Pipe Foundry, of Chattanooga, Tenn; the Chapman valves and hydrants were furnished by Ripley & Bronson, of New York. The supply is taken from wells sunk at the side of Fall river, with an extra suction at the river; during the winter the water was pumped direct, but a reservoir has now been built, to which the water is pumped; the reservoir has a capacity of 2,000,000 galls., and is at an elevation of 190 ft above the city. There is one compound and one high pressure pumping engine, with a daily capacity of 2,000,000 galls.; and two steel boilers, 160 H. P., made by J. O'Brien & Co., of St. Louis, Mo. There are 7 miles of pipe, 52 hydrants and 208 taps. Average daily consumption, 200,000 galls. Ordinary pressure, 100 lbs; direct fire pressure, 175 lbs. Cost of works, $120,000. No debt. Annual expenses, $2,500. Annual revenue from consumers, $5,000; from city, $3,120; from railroads, $1,000. The works are owned by the Fredonia Water Co., the principal officers being JAS. A. O'NEIL, H. L. JARBOE, and C. H. RACE; capital paid in, $125,000; no bonds issued. The franchise is for 20 years, unless sooner purchased by the city; the hydrant rental is $60 per hydrant per annum for 50 hydrants. Present population, 3,200. (Date of special report, Feb. 14, 1888.)